

AD-A037 904

COASTAL ENGINEERING RESEARCH CENTER FORT BELVOIR VA
WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS.(U)
JAN 77 E F THOMPSON
CERC-TR-77-1

F/6 8/3

UNCLASSIFIED

NL

1 OF 4
AD
A037904



ADA037904

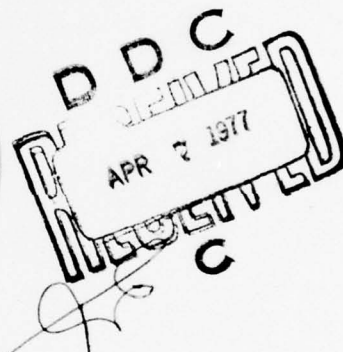
TR 77-1

Wave Climate at Selected Locations Along U.S. Coasts

by

Edward F. Thompson

TECHNICAL REPORT NO. 77-1
JANUARY 1977



Approved for public release;
distribution unlimited.

AD No. _____
DDC FILE COPY

U.S. ARMY, CORPS OF ENGINEERS
COASTAL ENGINEERING
RESEARCH CENTER

Kingman Building
Fort Belvoir, Va. 22060

Reprint or republication of any of this material shall give appropriate credit to the U.S. Army Coastal Engineering Research Center.

Limited free distribution within the United States of single copies of this publication has been made by this Center. Additional copies are available from:

*National Technical Information Service
ATTN: Operations Division
5285 Port Royal Road
Springfield, Virginia 22151*

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR 77-1 (1) CERRE-TR-77-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS.	5. TYPE OF REPORT & PERIOD COVERED Technical Report	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Edward F. Thompson	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of the Army Coastal Engineering Research Center (CERRE-OC) Kingman Building, Fort Belvoir, Virginia 22060	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS A31463 367 p.	
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army Coastal Engineering Research Center Kingman Building, Fort Belvoir, Virginia 22060	12. REPORT DATE January 1977	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES 364	
	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
Atlantic coast Wave analysis Wave heights Pacific coast Wave climate Wave periods Gulf coast Wave gages Wave records		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
<p>Since 1948, the Coastal Engineering Research Center (CERC) and its predecessor, the Beach Erosion Board (BEB) have gathered wave data from U.S. coastal locations. Staff and pressure-sensitive gages, generally shore-based, were used to obtain the data; a few gages were operated at offshore locations. Wave records were initially 7-minute pen and ink records taken six times a day, but more recently, 1,024-second digital records on magnetic tape taken four times daily have been used to determine significant wave heights and</p> <p>(Continued)</p>		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

059 050

mt

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

periods. Summaries of significant heights and periods for 19 gage locations provide useful information on ranges, and annual and seasonal variations of wave climate.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

PREFACE


This report is published to provide coastal engineers and coastal researchers with summaries of nearshore wave measurements from 19 locations along the Atlantic, gulf, and Pacific coasts. The work was carried out under the wave measurement program of the U.S. Army Coastal Engineering Research Center (CERC).

This report was prepared by Edward F. Thompson, Hydraulic Engineer, under the supervision of Dr. D. Lee Harris, Chief, Oceanography Branch.

The success of the CERC wave measurement program has been a result of the efforts of many people involved with the program since 1948. The assistance provided by Dr. Harris in the planning and preparation of this report is greatly appreciated. Particular recognition is given to the following people who designed, built, installed, and maintained the wave gages and associated electronics: C.M. Hare, F.W. Kellum, N.F. Lang, E.A. Maiolatesi, W.E. Robertson, C.H. Shepherd, Jr., and L.C. Williams.

Comments on this publication are invited.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.


JOHN H. COUSINS
Colonel, Corps of Engineers
Commander and Director

AMERICAN S. 100

TYPE ☒ Single Section

AND ☐ Full Section

EXPLANATION ☐

JUSTIFICATION

BY

EXPERIMENTAL/ANALYST'S NOTES

DATE ☐ APRIL AND OF SPECIAL

A

CONTENTS

	Page
CONVERSION FACTORS, U.S. CUSTOMARY TO METRIC (SI)	7
I INTRODUCTION.	9
II NEARSHORE WAVE CHARACTERISTICS AT THE GAGES	11
III WAVE GAGES AND RECORDERS.	20
1. Wave-Gage Types.	20
2. Comparison of Gage Types	22
3. Wave Recorders	23
4. Gage and Recorder Problems	27
IV ANALYSIS OF PEN AND INK WAVE RECORDS.	28
1. Introduction	28
2. Analysis Methods for Pen and Ink Wave Records. . . .	28
3. Comparison of Pen and Ink Record Analysis Methods	29
V ANALYSIS OF DIGITAL WAVE RECORDS.	30
VI COMPARISON OF RESULTS FROM SIMULTANEOUS DIGITAL AND PEN AND INK RECORDS	33
1. Introduction	33
2. Description of Data Sample	34
3. Comparison of Results.	34
4. Summary of Comparisons between Simultaneous Digital and Pen and Ink Records	51
VII COMPARISON OF WAVE CLIMATE FROM DIGITAL AND PEN AND INK RECORDS	51
LITERATURE CITED.	56
APPENDIX	
A EXPLANATION OF SUMMARIES OF SIGNIFICANT HEIGHT AND PERIOD.	59
A-1 SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. ATLANTIC COAST.	64
A-2 SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. GULF COAST.	228
A-3 SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. PACIFIC COAST	273
B PROCEDURE FOR ANALYSIS OF WAVE DATA FROM 7-MINUTE PEN AND INK RECORDS	361

CONTENTS

TABLES

	Page
1 Wave period resolution of the CERC procedure for analyzing digital wave records	33
2 Comparison of significant wave height estimates from digital and pen and ink records, Savannah Light Tower, Georgia, September 1971 to April 1972	35
3 Correlation between significant wave estimates from digital and pen and ink records taken during September 1971 to April 1972	37
4 Comparison of significant wave height estimates from digital and pen and ink records at Wrightsville Beach, North Carolina, September 1971 to April 1972	38
5 Comparison of wave period estimates from digital and pen and ink records, Savannah Light Tower, Georgia, September 1971 to April 1972.	42
6 Comparison of significant wave height statistics from digital and pen and ink records taken during September 1971 to April 1972	46
7 Comparison of wave period statistics from digital and pen and ink records taken during September 1971 to August 1972	48

FIGURES

1 BEB-CERC wave gage locations.	10
2 Aerial photo of several wave trains along the California coast north of Pt. Mugu, 9 August 1973	12
3 Example of energy spectra from the CERC gage at Atlantic City, New Jersey	13
4 Example of energy spectra from the CERC gage at Naples, Florida.	15
5 Example of energy spectra from the CERC gage at Huntington Beach, California.	17
6 Aerial photo showing superimposed trains of sea and swell waves south of Port Hueneme, California, 3 August 1960	19
7 Comparison of root-mean-square (RMS) sea surface elevations from pressure- and step-resistance gage records with those from continuous-wire gage records.	23

CONTENTS

FIGURES--Continued

	Page
8 Oblique photo of step-resistance gage near Chesapeake Beach, Maryland	24
9 Examples of wave records from Lake Worth, Florida, 27 January 1966, and Nags Head, North Carolina, 15 April 1975	25
10 Example of wave record from Wrightsville Beach, North Carolina, 27 May 1972.	26
11 Shallow-water wave profile for $H/L_0 = 0.0117$ and $D/L_0 = 0.010$.	39
12 Example of wave record from Savannah Light Tower, Georgia, 29 May 1972.	41
13 Example of wave record from Savannah Light Tower, Georgia, 22 September 1971.	43
14 Example of wave record from Savannah Light Tower, Georgia, 27 May 1972.	45
15 Comparison of distribution functions of significant wave height estimated from digital and pen and ink records taken during September 1971.	49
16 Comparison of distribution functions of wave period esti- mated from digital and pen and ink records taken during September 1971 to April 1972	50
17 Annual means and standard deviations of significant wave height from 19 gage locations.	53
18 Annual means and standard deviations of significant wave period from 19 gage locations.	54

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U.S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	by	To obtain
inches	25.4	millimeters
	2.54	centimeters
square inches	6.452	square centimeters
cubic inches	16.39	cubic centimeters
feet	30.48	centimeters
	0.3048	meters
square feet	0.0929	square meters
cubic feet	0.0283	cubic meters
yards	0.9144	meters
square yards	0.836	square meters
cubic yards	0.7646	cubic meters
miles	1.6093	kilometers
square miles	259.0	hectares
knots	1.8532	kilometers per hour
acres	0.4047	hectares
foot-pounds	1.3558	newton meters
millibars	1.0197×10^{-3}	kilograms per square centimeter
ounces	28.35	grams
pounds	453.6	grams
	0.4536	kilograms
ton, long	1.0160	metric tons
ton, short	0.9072	metric tons
degrees (angle)	0.1745	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins ¹

¹To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use formula: $C = (5/9)(F - 32)$.
To obtain Kelvin (K) readings, use formula: $K = (5/9)(F - 32) + 273.15$.

WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS

by
Edward F. Thompson

I. INTRODUCTION

In support of its mission to conduct research on coastal phenomena of engineering importance, the Coastal Engineering Research Center (CERC) and its predecessor, the Beach Erosion Board (BEB) have operated wave gages in the nearshore environment for more than 25 years. The results of this effort provide the coastal researcher and the coastal engineer with important data on waves arriving at U.S. coasts in response to a variety of meteorological conditions; however, an equally important result is the specification of the annual and seasonal significant wave height and period climate at various coastal locations.

Knowledge of the ocean wave climate is important for planning coastal operations, estimating coastal sediment movement, designing coastal structures, and for other applications. However, because recording and analyzing reliable wave climate data are expensive and time consuming, there is a paucity of field wave data. Thus, the primary purpose of this report is to present summaries of significant heights and periods from the BEB-CERC field wave-gaging program at the 19 locations shown in Figure 1. A secondary purpose is to provide details and a perspective on the various wave measurement, recording, and analysis systems used by BEB-CERC. Similar wave-gaging programs are ongoing in shallow water along the southern California coast (Seymour, et al., 1976) and in deep water along Canadian coasts (Wilson and Baird, 1972).

Although there is presently no suitable substitute for accurate near-shore wave measurements, data obtained from the gages must be carefully interpreted. The waves being measured must be considered: Are the waves breaking or have they already broken? For surface gages, are these deep-water waves not yet affected by refraction and shoaling? These questions are discussed in Section II.

Aside from the variability of the waves being measured, the ability of the wave recording and analysis system to translate the waves in nature into accurate and useful results must be evaluated. Several important problems in the BEB-CERC system were probably unavoidable in a wave recording and analysis system under development for two decades. Different gage types, recording schemes, and methods for analyzing wave records have been used. Also, many gaps exist in the recording sequences. Each of these factors can introduce biases in the summarized data.

Three basic wave gages have been used in the BEB-CERC wave data collection program: Two staff gages (the step-resistance gage and the continuous-wire gage) and an underwater pressure-sensitive gage. The gages and the wave recording schemes used are discussed in Section III.



Figure 1. BEB-CERC wave gage locations.

Data recording and analysis techniques are discussed in Sections IV, V, and VI. Section IV discusses the different methods used by CERC for analyzing pen and ink records; Section V discusses the recording and spectral analysis of CERC's digital wave records on magnetic tape. In Section VI, significant wave heights and periods obtained from pen and ink records are compared with results from digital records.

The dependence of annual wave summaries on data analysis techniques and coastal location is described in Section VII.

The contents and format of the summaries of significant wave height and period are explained in Appendix A. Most summarized data were obtained with staff gages ranging from 4.6 to 13.7 meters (15 to 45 feet) in length and mounted on or near the seaward end of a pier. The ocean bottom at the gages ranged from 4 to 30 meters (13 to 100 feet) below mean sea level (MSL); however, none of the shore-based gages were in water deeper than 7.6 meters (25 feet).

The summaries, including results from both digital and pen and ink data, are presented in Appendix A for locations on the Atlantic coast, the gulf coast, and the Pacific coast.

II. NEARSHORE WAVE CHARACTERISTICS AT THE GAGES

Waves traveling from deep water into shallow water are modified by such processes as refraction, shoaling, and reflection. When several wave trains with different frequencies are present, these modifications can be complex. In such cases, energy transfer between wave trains can also be important.

Several different wave trains, each with a different wavelength and coming from a different, clearly defined direction, are usually visible in clear aerial photos of coastal waves. The photos often show short, choppy sea waves superimposed on several trains of long, regular swell waves. An example of multiple wave trains is shown in Figure 2.

Energy spectra obtained from CERC gages support the hypothesis that several wave trains with different energy and frequency are common (Thompson, 1974; McClenan and Harris, 1975). Examples from the Atlantic, gulf, and Pacific coasts are shown in Figures 3, 4, and 5. These data also indicate that occasionally, finely tuned unimodal spectra do occur.

Aerial photos of good quality are useful for observing wave modification and often show a remarkable change in the relative dominance of different frequency wave trains as the waves move into very shallow water nearshore. Some low-frequency wave trains which are nearly invisible offshore amidst higher frequency waves, have been observed to increase in prominence very nearshore to the point that, in the breaker zone, the train totally dominates the shorter waves present (Harris, 1972a; McClenan and Harris, 1975; U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, p. 3-4). This phenomenon is shown in Figure 6.



Figure 2. Aerial photo of several wave trains along the California coast north of Pt. Mugu, at 1300 hours, 9 August 1973.

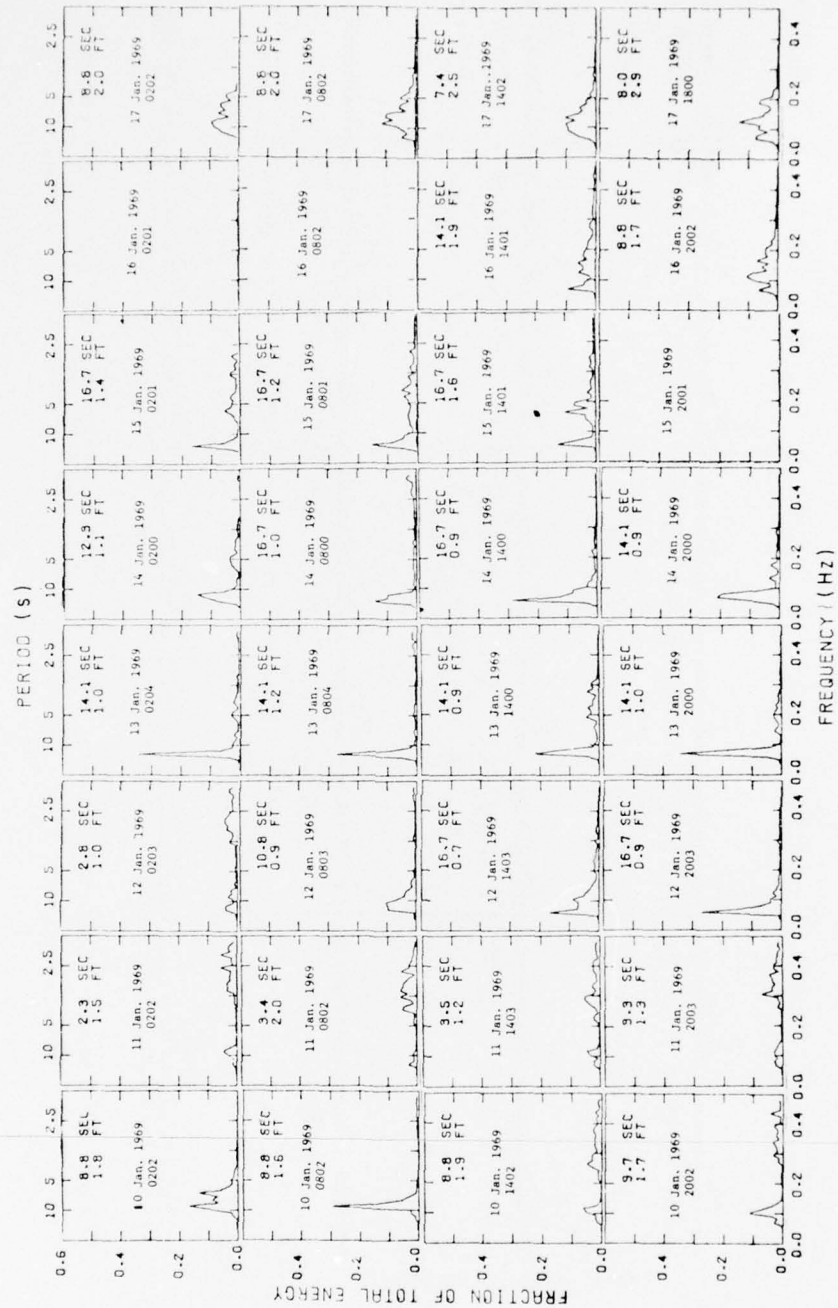


Figure 3. Example of energy spectra from the CERC gage at Atlantic City, New Jersey. Significant wave height and period estimates are given in the upper part of each spectrum.

BEST AVAILABLE COPY

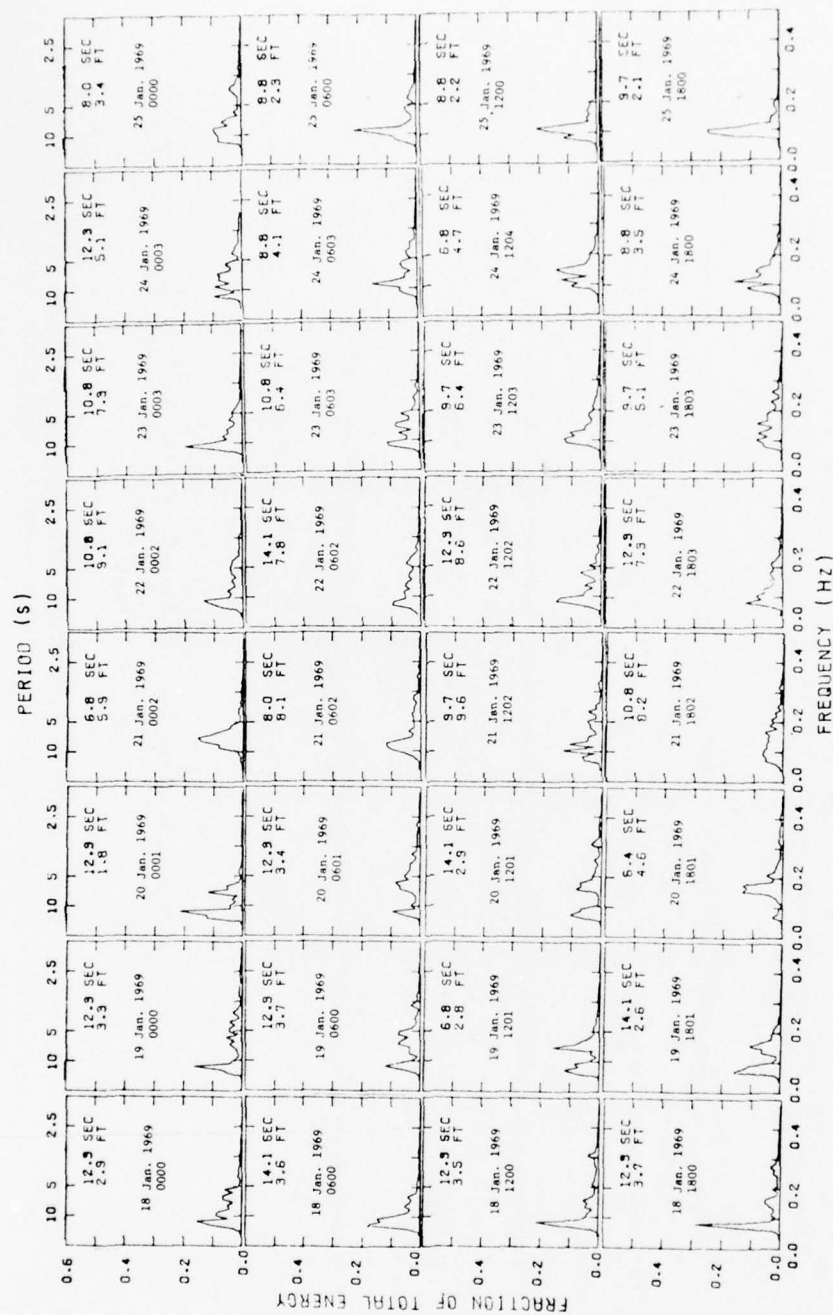


Figure 3. Example of energy spectra from the CERC gage at Atlantic City, New Jersey.
--Continued

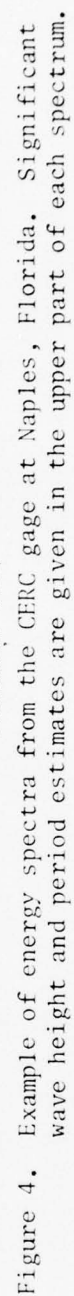


Figure 4. Example of energy spectra from the CERC gage at Naples, Florida. Significant wave height and period estimates are given in the upper part of each spectrum.

BEST AVAILABLE COPY

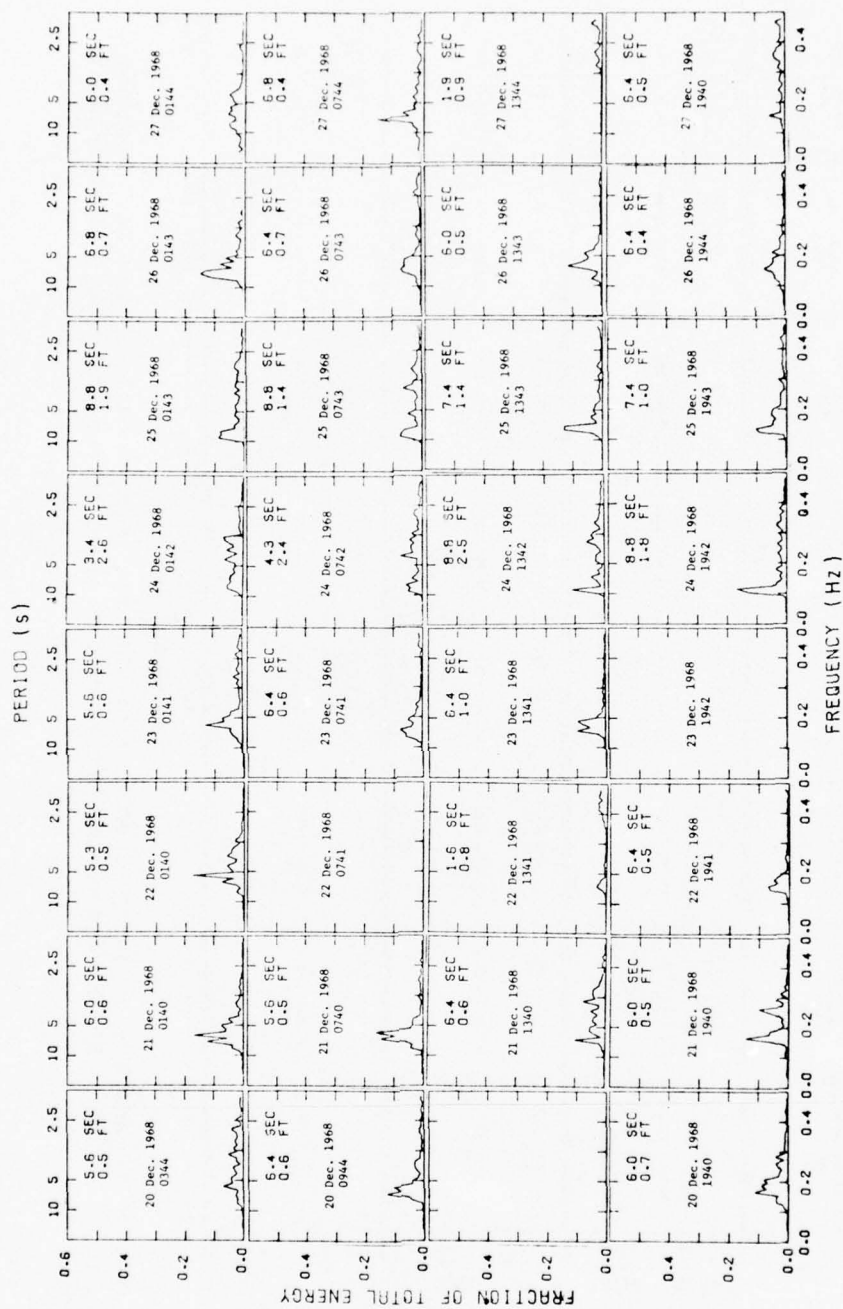


Figure 4. Example of energy spectra from the CERC gage at Naples, Florida.--Continued

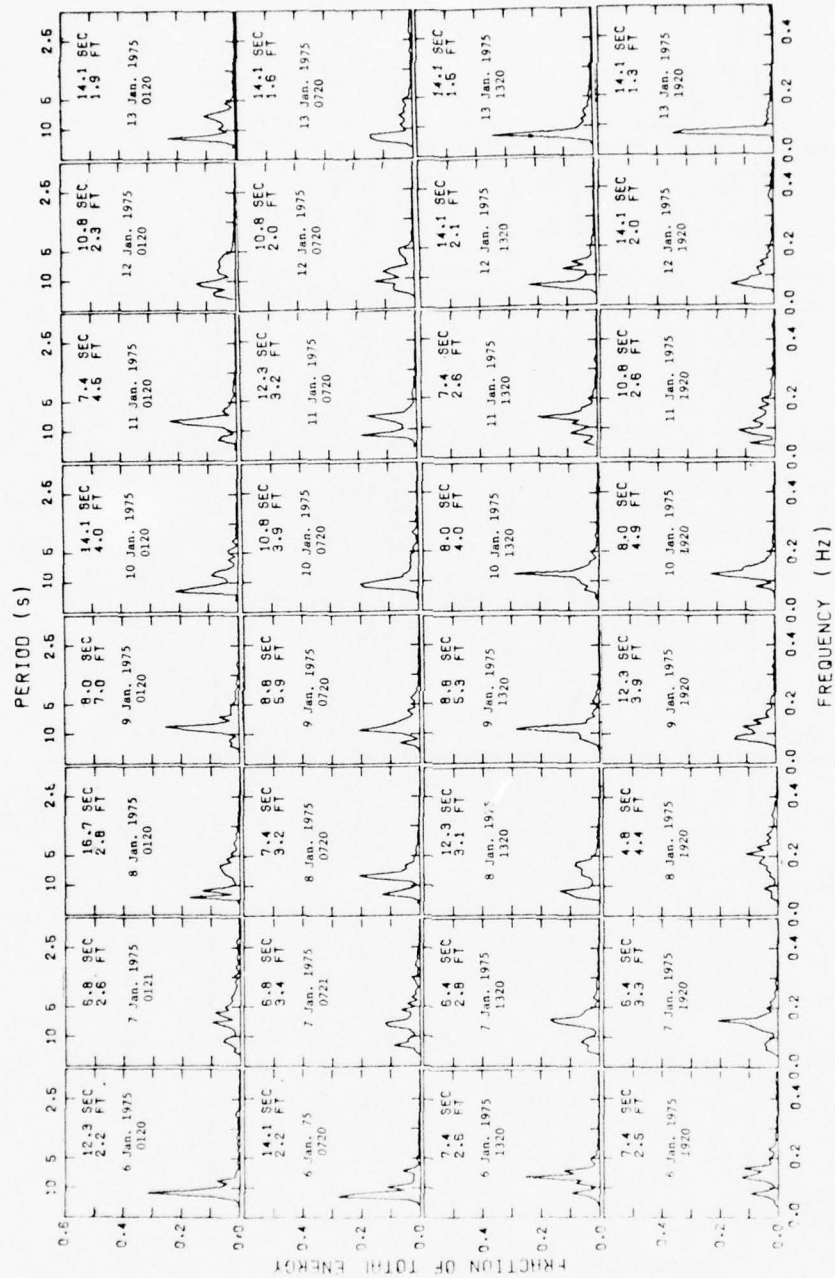


Figure 5. Example of energy spectra from the CERC gage at Huntington Beach, California. Significant wave height and period estimates are given in the upper part of each spectrum.

BEST AVAILABLE COPY

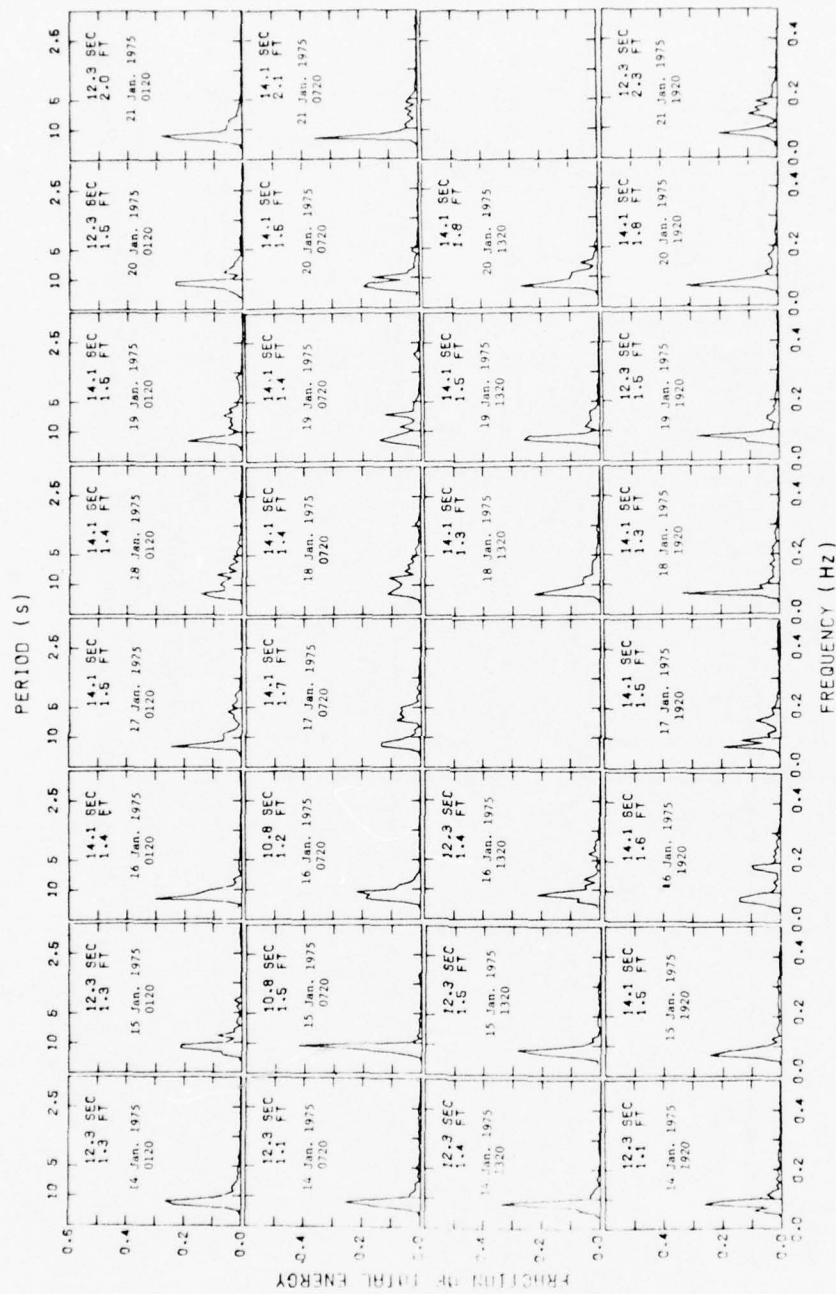


Figure 5. Example of energy spectra from the CERC gage at Huntington Beach, California.
--Continued



Figure 6. Aerial photo showing superimposed trains of sea and swell waves south of Port Hueneme, California, on 3 August 1960. The train of swell waves is nearly invisible offshore but is dominating the breaker zone.

Since offshore bottom topography, coastal exposure, and local currents are different at every coastal location, the coastal wave climate can also differ. Wave height can vary considerably, particularly alongshore between points on a given nearshore depth contour (Harris, 1972a; McClenan and Harris, 1975; U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, pp. 2-65 to 2-77; p. 2-112). This variability is expected to be small for short distances along a coastal area with relatively uniform topography and exposure.

Wave frequency can usually be considered unchanged as waves move into shallow water; aerial photos generally indicate no loss of integrity of waves during the refraction and shoaling processes. However, in some situations, a wave in shallow water can break down into several shorter waves (Galvin, 1972; McClenan and Harris, 1975).

Wave frequency, as determined from a measurement point fixed in space, can also be modified by local currents. A current opposing the waves decreases the frequency; a following current increases the frequency.

The placement of wave gages by BEB-CERC has been limited by practical considerations. Since staff gages require a rigid mounting structure, most BEB-CERC staff gages have been located near the seaward end of ocean piers to gain optimum exposure to waves from different directions and to keep the gages seaward of the breakers for most wave conditions. However, most waves reaching the gages have been appreciably altered by bottom effects. At times, waves arriving at a gage have already negotiated an offshore bar seaward of the pier on which the gage is mounted; occasionally, high waves break seaward of the gage.

Ocean waves measured at the gages are rarely either deepwater waves or breakers; however, accurately measured and properly interpreted, the waves provide a good indication of the wave frequencies and wave heights approaching shore.

III. WAVE GAGES AND RECORDERS

1. Wave-Gage Types.

a. Step-Resistance Gage. Most step-resistance gages used in the wave-gaging program at BEB and initially at CERC, were designed and fabricated at BEB (Williams, 1969). These gages used electrical contact points along the staff to sense water surface elevations. The contact points are embedded, usually at 0.06-meter (0.2-foot) intervals, in 1.5-meter-long (5-foot) epoxy resin sections which are designed to slide easily into a steel or aluminum H-beam frame securely clamped to a piling, steel pipe, or other rigid support.

Step-resistance gages are classified as spark plug, parallel, or relay types, and are all similar in appearance. The spark plug type was used only in the beginning of the BEB wave-gaging program. The parallel type has been developed for use in saltwater of fairly constant salinity.

The relay type is designed for use in either saltwater, freshwater, or water of highly variable salinity.

b. Continuous-Wire Gage. The continuous-wire gage now used by CERC is a type manufactured by the Baylor Company, Sugar Land, Texas, and consists of two parallel stainless-steel cables in tension, spaced about 23 centimeters (9 inches) apart. Braces at both ends of the cables are firmly attached to a rigid support. Spacers are usually placed at intermediate points along the cables to ensure proper separation. The gage produces an electrical output proportional to the length of cable above the short circuit imposed by the sea surface.

This rugged gage is capable of operating very well along any exposed ocean coast and is insensitive to biological fouling or to small variations in salinity; however, it is unsatisfactory for use in freshwater, or brackish water. Failure of the gage is frequently caused by lightning damage to gage circuitry. Continuous-wire gages are presently used at all CERC staff-gage locations where electrical conductance of the water is sufficiently high.

c. Pressure-Sensitive Gage. Submerged pressure-sensitive gages are useful at locations with cold winters where ice would form on a staff gage and render it inoperable and at locations where no suitable structure for gage mounting is available or where a staff gage would interfere with navigation. Pressure gages can be placed on the ocean floor in shallow water.

The first pressure gage used by the BEB had a bellows that changed in length in response to water pressure variations (Williams, 1969). The bellows movement was coupled to the core of a linear differential transformer which produced an electrical signal that was amplified and recorded. A new pressure-gage design was adopted in 1964 which used strain gages rather than a bellows (Peacock, 1974).

A pressure-gage record is always damped in comparison to a staff-gage record, because the pressure pulse due to a surface wave is attenuated with increasing depth of measurement. For intermediate and low-frequency waves, the pressure record can usually be compensated for gage submergence with frequency-dependent compensation factors (Esteva and Harris, 1970); for high-frequency waves with wavelengths shorter than twice the water depth, the pressure record is often attenuated beyond recovery.

Local currents can affect apparent wave frequencies. A wave in a current with a component of velocity in the direction of wave travel passes a fixed gage more rapidly than a wave of equivalent length outside the current. Thus, the apparent frequency of the wave in the gage record is inappropriately high for the wavelength. The frequency-dependent compensation factor applied to such a record and the resultant wave height estimate would be too high. Similarly, for a wave in a current with a component of velocity opposing the wave motion, the wave height estimate would be expected to be too low.

Pressure gages are susceptible to biological fouling; however, with routine maintenance, fouling has not been a major problem with gages now used by CERC.

2. Comparison of Gage Types.

Since the three types of wave gages do not respond identically to a given sea state, each may be associated with a small individual bias. To evaluate the relative responses, a continuous-wire gage, a step-resistance gage, and two pressure gages (2.6 and 4.3 meters below MSL), were mounted 3.7 meters (12 feet) apart on the end of Steel Pier in Atlantic City, New Jersey (Esteve and Harris, 1970). Wave data were recorded as 20-minute digital records on magnetic tape, and 12 records per day for 1 week were analyzed. The standard deviation of each digital record, referred to as the root-mean-square (RMS) elevation, was computed as an estimate of wave height. RMS elevations for pressure gages were compensated according to linear wave theory to conform to surface measurements. RMS elevations from the pressure- and step-resistance gages were plotted as a function of RMS elevation from the continuous-wire gage (Fig. 7). Data from both pressure gages compared favorably with data from the wire gage. However, most data from the step gage were higher than data from the wire gage. Significant height estimates (four times the RMS elevation) obtained from a step-gage record appeared to be about 1 foot higher for low and moderate wave conditions and about 20 percent higher for high-wave conditions (Fig. 7).

One reason why the step-resistance gage is biased toward higher wave readings is that waves striking the gage tend to run up the inside of the H-beam which supports the gage (Fig. 8; see also Fig. 12 in Williams, 1969). During long-term unattended field use, thick biological growth on the gage can slow gage response to wave troughs, and severe growth can continue to short out the gage at a particular elevation even when the sea surface drops momentarily below that elevation.

3. Wave Recorders.

a. Recorder Types. Data from two types of wave recorders have been used for this study. The earlier BEB main recorder type was the pen and ink strip-chart recorder; sample records are shown in Figures 9 and 10. The pen motion is controlled by a voltage signal which increases and decreases in response to momentary changes in sea surface elevation at the gage. The pen and ink recorder was activated by timer-driven switches at regular intervals.

A digital magnetic tape recording scheme has been implemented at CERC within the last 10 years. In this recording scheme, the voltage signal from the gage is converted to a frequency-modulated signal, transmitted to the CERC laboratory via telephone line, reconverted to a voltage signal, converted to a digital signal, and finally recorded in a binary-coded decimal format on 0.5-inch magnetic tape at the rate of four data points per second. The recorder operates continuously, switching automatically to a new gage or group of gages every 20 minutes.

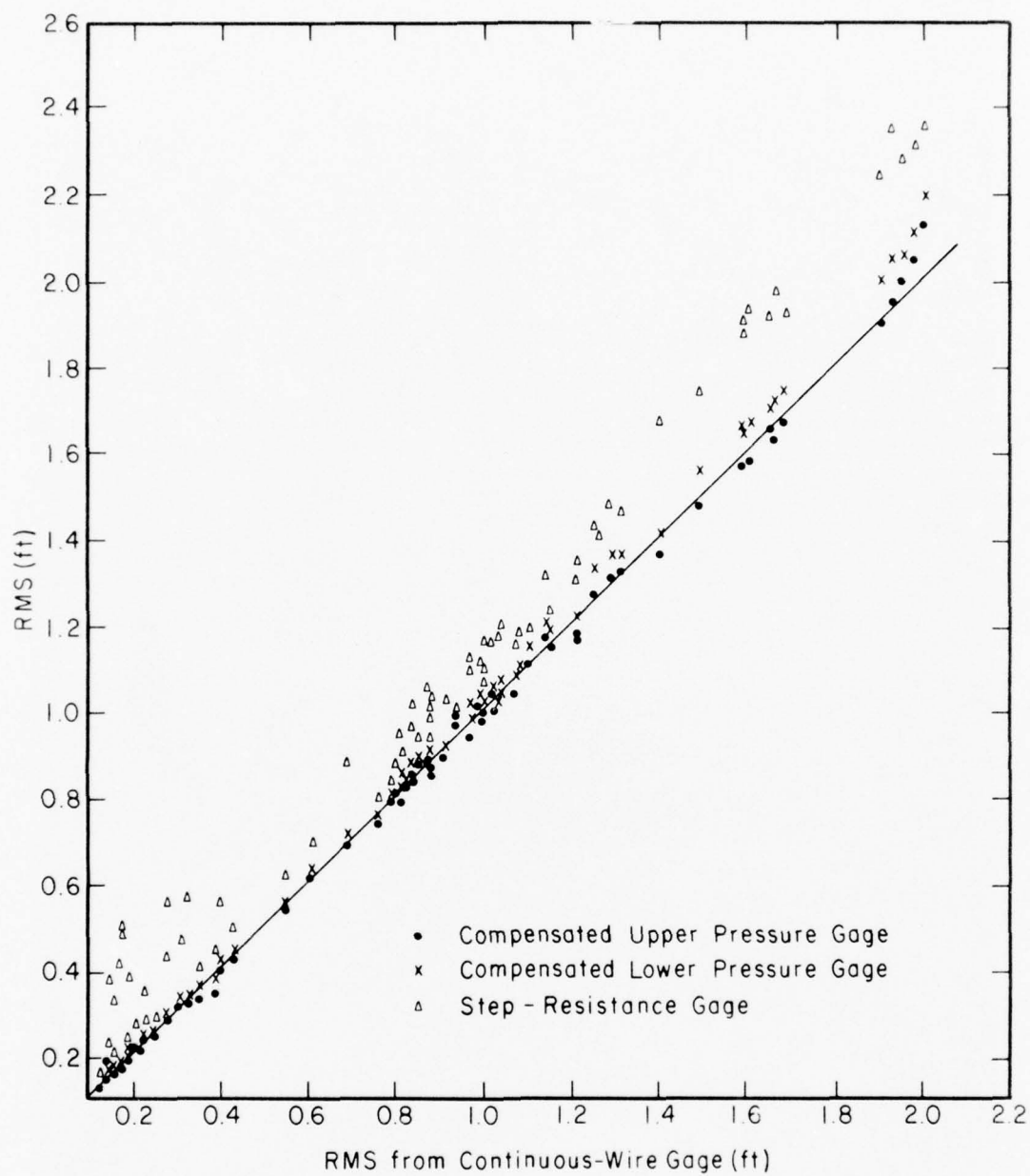
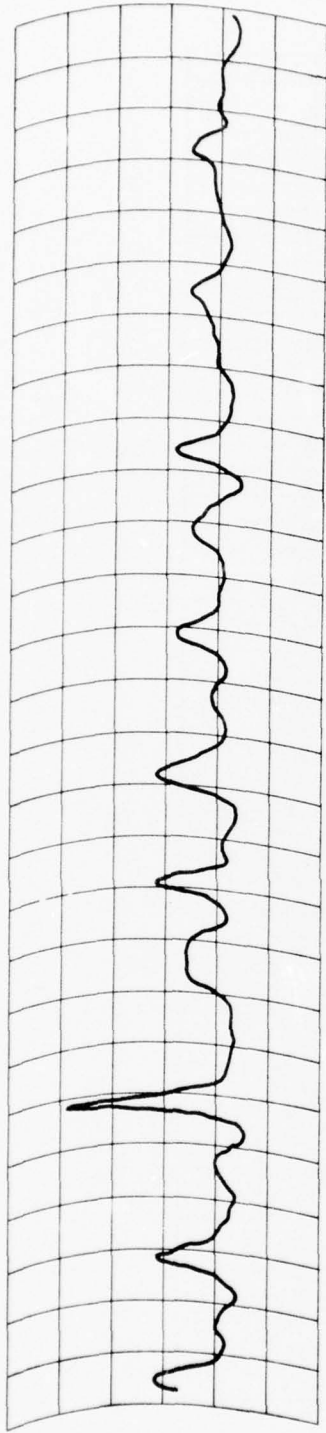


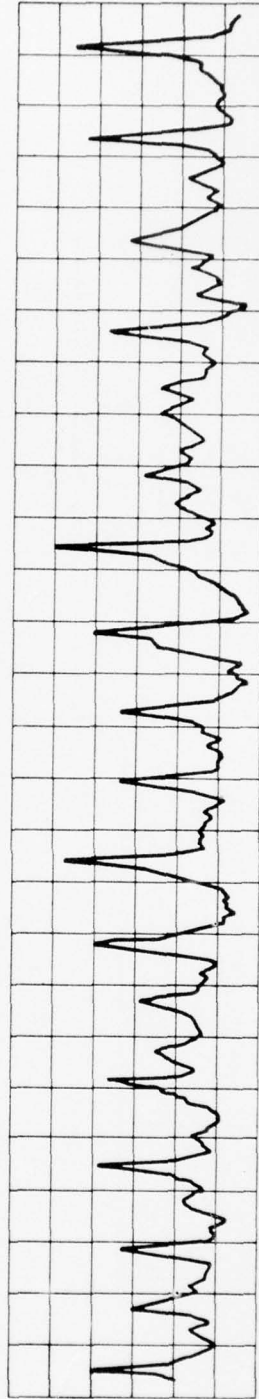
Figure 7. Comparison of root-mean-square (RMS) sea surface elevations from pressure- and step-resistance gage records with those from continuous-wire gage records (Esteve and Harris, 1970).



Figure 8. Oblique photo of step-resistance gage near Chesapeake Beach, Maryland.

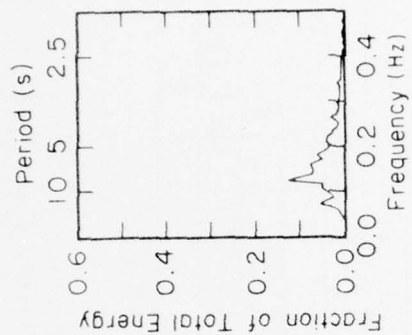


a



b

Figure 9. Examples of wave records from: (a) Lake Worth, Florida, at 2215 hours, 27 January 1966; (b) Nags Head, North Carolina, at 1300 hours, 15 April 1975.



Data Type	Significant Height (ft)	Wave Period (s)
Pen and Ink	8.0	8.0
Digital	5.9	8.0

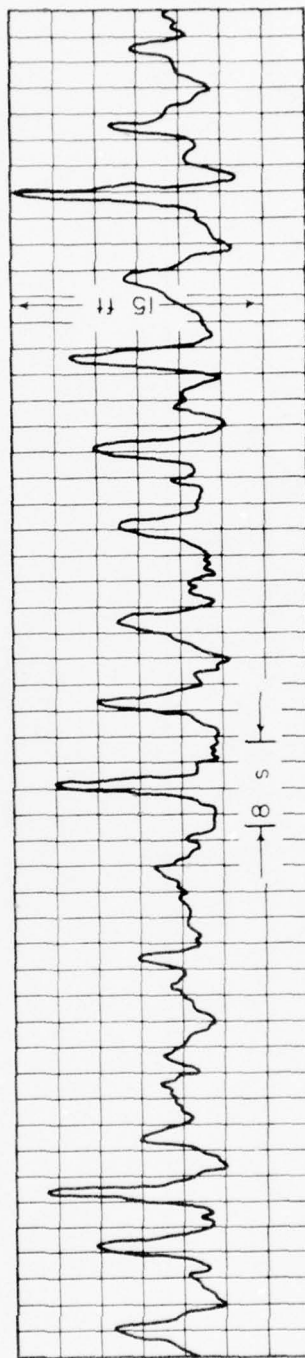


Figure 10. Example of wave record from Wrightsville Beach, North Carolina, at 0100 hours, 27 May 1972.

b. Changes in Recording Procedure. For most of the recorded data, the pen and ink strip-chart recorder ran for 7 minutes each time it was activated (at 4-hour intervals before August 1971 and 6-hour intervals after that date). After April 1975, the standard record length was decreased to 4 minutes. Records taken before January 1970 were on curvilinear paper; records from 1970 to the present are on rectilinear paper (Fig. 9).

Before 1966, all recorders were located at the gage sites and were tended by local people under contract to mail the completed rolls of chart paper to BEB-CERC, to install fresh rolls of chart paper when necessary, and to report any malfunction of the equipment. After 1966, the signals from some gages were sent instantaneously over telephone lines to the CERC laboratory. Since November 1968, the signals from most gages have been routinely sent over telephone lines, converted to digital form, and recorded on magnetic tape.

Digital signals from four gages were recorded simultaneously after March 1971. This procedure is accomplished with an electronic multiplexer which successively samples each of the four gage signals every 1/16 second, so that a data point from any particular gage signal is obtained every 1/4 second.

One 20-minute digital record per hour was obtained for each gage signal before February 1973, accommodating 12 gage signals by the recording sequence. However, since that date more than 12 gage signals have been received and the recording sequence modified to provide one 20-minute record every 2 hours for each gage signal.

Although digital records for each gage recorded are available every 1 or 2 hours, only four digital records per day are routinely analyzed. Pen and ink records taken during time periods covered by digital records are not routinely analyzed, but are used mainly for quality control and for special tests. The pen and ink records also provide a backup when the digital recorder is inoperative. If known in advance that pen and ink records will be analyzed, records longer than 4 minutes can be obtained.

4. Gage and Recorder Problems.

Maintaining an operating wave gage in coastal waters is difficult. To minimize problems, BEB-CERC generally performed routine maintenance twice a year on both step-resistance and pressure gages which consisted of a thorough cleaning and recalibration of the gage and often cleaning and repainting of the H-beam or other supporting structures. Routine maintenance of continuous-wire gages has not been necessary.

In spite of regular maintenance and improvements in wave-gaging systems, interruptions in the recording sequence have been caused by storm waves, lightning, fire, electricity cutoffs, biological organisms, vandals, and errant boats striking the gage.

Some of the common problems which result in missing records with the onsite pen and ink recorders are: (a) Sticking of the recorder pen in one position or running out of ink, (b) failure to promptly replace the chart paper rolls, (c) failure to date the records, and (d) mailed records never reaching CERC.

A major problem with the digital magnetic tape recorder is electronic noise in the data. Noise is fairly common on telephone lines, and although analysis procedures can cope with some types of noise, it is still a problem. Minor, less frequent problems are tape-reading difficulties, power failures, and recorder malfunctions.

IV. ANALYSIS OF PEN AND INK WAVE RECORDS

1. Introduction.

Despite the many problems associated with efforts to measure ocean waves, CERC has accumulated a large volume of pen and ink records. Unless the sea is very calm, these records usually indicate waves with a variety of heights and periods and often show a complex interaction between several distinct wave trains with different heights and periods. Examples of recorded waves are shown in Figure 9.

For practical use, the information in the pen and ink records is usually reduced to a few concise parameters which define a sea state and can be used to form statistical summaries of sea states. These simplified data can be used more readily than the original pen and ink records for the solution of most coastal problems.

Each wave record is usually characterized by a wave height parameter and a wave period parameter. The most commonly used characteristic wave height has been the "significant" height. Significant height was originally proposed by Sverdrup and Munk (1948), who recommended that the wave height estimate be based on the higher waves in the record. They proposed the average height of the one-third highest waves in the record as a reasonable estimate of wave height. The concept of a significant wave height has proved useful in coastal and ocean engineering, and numerous methods have been developed for estimating significant height.

A single measure of wave period has not been as clearly defined. Most pen and ink record analysis methods give no more than a rough averaging of periods of the higher waves; this estimate is usually referred to as the "significant" period.

BEB-CERC has used several different methods to estimate significant wave height and period from pen and ink records; these methods are discussed below.

2. Analysis Methods for Pen and Ink Wave Records.

a. First BEB Method. This first method of pen and ink wave record analysis (started by BEB in 1948) used an average wave period (significant period), measured crest-to-crest, determined from sequences of high,

well-defined waves in the record. The record length was usually 7 minutes, and was divided by the significant period to obtain an estimate of the total number of waves in the record. The heights, measured from crest to preceding trough, of the highest one-third waves were then measured and averaged to give a significant wave height for the record.

b. Second BEB Method. The second BEB method for pen and ink record analysis, adopted in 1953 or 1954, was quicker than the first method. This procedure required the person performing the analysis to select a 1-minute sample from the record which contained the highest and most uniform waves. Then, a wave-period template was used to estimate a significant period for the high, uniform waves. According to the significant period, the height of the first, second, or third highest wave in the 1-minute sample was measured and used as an estimate of the significant wave height.

c. CERC Method. In January 1965, a third pen and ink record analysis was adopted at CERC. This method used the full 7-minute wave record, was fairly fast, and was more discriminating than the second BEB method. A wave-period template was used to estimate the period of the higher and more uniform waves in the record. The length of the record divided by the significant period, gave an estimate of the total number of waves in the record. Assuming that the Rayleigh distribution applied for heights of individual waves in a record (see U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, pp. 3-5 to 3-11), the rank, n , of the wave which would theoretically have a height equal to the significant height, was determined. The height of the n th highest wave in the record was measured and used as the estimate of significant height. Step-by-step instructions for this analysis method are given in Appendix B.

This third analysis method is now used at CERC when significant wave heights and periods must be estimated from pen and ink records. However, the procedure is no longer carried out routinely.

3. Comparison of Pen and Ink Record Analysis Methods.

Methods used by BEB-CERC for analyzing pen and ink wave records often give different results when applied to the same wave records. These methods, particularly the second BEB method which required selection of a 1-minute sample, are also fairly subjective; the results are dependent upon the individual analyzing the record. The CERC method is more objective, and is considered to give more reliable results.

Since results of all three pen and ink record analysis methods are included in this study, some of the old BEB pen and ink records were reanalyzed using the CERC method. Linear regression equations were computed, relating results from the CERC method to the old analyses; significant height estimates derived were found to average about 20 percent lower than height estimates from the BEB method. Significant period estimates were reasonably comparable to each other. Additional details of this study are in Appendix A.

Harris (1970) compared the CERC method with other accepted methods for estimating significant wave height and period from pen and ink records and found correlations above 0.9 with wave height estimates from a method based on the highest crest and the lowest trough, as recommended by Tucker (1961). Harris also found high correlations between height estimates from the CERC method and the average height of the one-third highest waves in the record.

Methods of estimating wave period from pen and ink records considered by Harris (1970) were the CERC method, the average period between upward zero crossings, the average period between all waves, and the average period of the one-third highest waves. Correlations between estimates from the CERC method and the other methods were below 0.25 except for estimates from the zero-crossing method which gave correlations of 0.39 to 0.55.

V. ANALYSIS OF DIGITAL WAVE RECORDS

Techniques for recording and analyzing digital wave data in the last 15 years have improved considerably, and digital data are now attractive for several reasons. Digital data permit direct computer analysis, providing objective, repeatable estimates of significant height and period, and facilitate computation of wave variance or energy spectra which provide more information about the wave field. Spectra are also useful for solving some engineering problems.

CERC has been recording digital wave data since 1966; data from each gage are recorded at the rate of four points per second for a duration of 20 minutes every 1 or 2 hours. The standard CERC computer analysis uses 4,096 data points or 17 minutes and 4 seconds of data for each gage record processed; one record is processed every 6 hours for each gage. The standard analysis has been applied to most of the available acceptable digital data.

The first step in the CERC computer analysis program is to edit the digital record selected for analysis. Editing routines check for non-numeric characters or anomalous spikes and jumps in the record, and usually interpolate across a few bad or highly questionable data points; however, if the data contain more than five consecutive bad points or if more than 2.5 percent of the data points are bad, the routines reject the record as unsuitable for analysis.

If the record is accepted, the distribution function for the accepted data points and its first five moments are computed. The second and third moments are checked for a reasonable comparison against criteria supplied in the program.

After the credibility of a record has been verified, the program applies a data window to the data points of the form:

$$\frac{y(t)}{2} \left(1 - \cos \frac{2\pi t}{T} \right),$$

where $y(t)$ is the data point at time, t , and T is the record length. Application of a data window results in greater resolution for the frequency spectrum of the record. This procedure decreases the variance of the data points, and the variance or energy of the original data points, $y(t)$, is retained for estimating significant wave height. The use of data windows is discussed by Bingham, Godfrey, and Tukey (1967), Briscoe (1972), and Harris (1974).

After application of the data window, the program computes the variance spectrum, often called the energy spectrum because the potential energy in the wave record is proportional to the variance of the record. This computation involves assigning a part of the energy to each of 1,024 different frequencies. The spectrum is computed by a method based on the finite Fourier transform technique (Bingham, Godfrey, and Tukey, 1967; Tukey, 1967). To gain statistical stability and to reduce extraneous detail, the energy assigned to several successive frequencies in the computed spectrum is combined to give an array of energy estimates for a series of frequency bands of equal width (usually 0.0107 hertz).

In the standard CERC procedure, spectra are then normalized by dividing the energy assigned to each band by the total spectral energy over a specified range of frequencies. The range of frequencies which the total energy represents is referred to as the *normalization interval*. The normalization interval for surface wave records is usually 0.033 to 1.0 hertz for staff gages, which corresponds to wave periods of 1 to 30 seconds. Normalized spectra facilitate investigation of spectral shapes; examples computed at CERC are shown in Figures 3, 4, and 5.

The spectral analysis of data from submerged pressure-sensitive gages requires some additional calculations. The pressure gage senses a signal which is attenuated by the water over the gage. The amount of attenuation increases with the frequency of the surface waves and the depth of submersion. To compensate the spectrum of a pressure-gage record for attenuation, the variance assigned to each spectral band is multiplied by a factor (greater than or equal to one) derived from linear wave theory. The compensated spectrum is then renormalized.

Compensated pressure spectra are generally based on a more restrictive normalization interval, with a lower high-frequency cutoff than spectra derived from staff gage records. The selection of a high-frequency cutoff for compensated pressure spectra becomes increasingly difficult and critical as water depth over the gage increases.

The standard CERC spectral analysis program is occasionally modified for special applications; e.g., successive data points obtained in laboratory experiments may be separated by a smaller time interval than the standard 0.25-second interval used for field data. A longer time interval between data points and a longer duration of the record are required for harbor resonance studies.

The standard analysis program has also been applied to data not acquired in the standard format. In these cases, the program controls are usually chosen to make the analyses as comparable as possible to the standard analyses. Nonstandard analyses have not been included in this study.

Complete spectra are difficult to interpret for many engineering applications; significant wave height and period provide a convenient and readily used indicator of wave conditions, and for compiling statistical summaries of sea states, are easier to handle than complete, but complex descriptions of wave conditions.

Significant wave height for a digital wave record is approximately equal to four times the standard deviation of the record (U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, p. 3-12). For pressure records, this estimate of significant height must be suitably compensated to represent surface wave conditions. The magnitude of the compensated significant height is quite sensitive to the high-frequency cutoff applied to the spectra, especially for data from relatively deep gages or from locations with considerable high-frequency wave energy.

At CERC and other organizations, the dominant wave period for a digital record is defined as the period associated with the frequency at the middle of the spectral band with maximum energy. Since the spectral bands are of equal frequency width, the analysis provides uniform resolution in frequency. However, wave period is the reciprocal of frequency, and the resolution in period is not uniform. If the data are summarized for equal resolution in period, the energy assigned to a greater number of individual frequencies must be combined for short periods than for long periods.

Only a discrete set of period values are possible with the standard digital analysis. When the data are summarized in equal width period intervals, a given period interval may be distorted by one more or less period value than is representative for the interval. This effect is important only for adjacent intervals encompassing few discrete period values or frequency bands; e.g., Table 1 shows that the 13- to 14-second interval contains no period values, and that the 8- to 9-second interval contains two period values while both the 7- to 8- and the 9- to 10-second intervals contain only one. Thus, a false concentration of period values could be expected in the 8- to 9-second interval.

When two wave trains occur, the present system of defining the significant wave period emphasizes the longer period waves. In using uniform period increments, the shorter period would be favored. The present system was adopted because of: (a) Directness, (b) an accurate knowledge of wave frequency is more important than an accurate knowledge of wave period in many practical problems, and (c) longer waves are more important than shorter waves of similar height in many applications. Complete information about all wave trains can be obtained only from the full spectrum.

Table 1. Wave period resolution of the CERC procedure for analyzing digital wave records.

Wave period interval (s)	Number of frequency bands in interval
1 to 2	47
2 to 3	15
3 to 4	8
4 to 5	4
5 to 6	4
6 to 7	2
7 to 8	1
8 to 9	2
9 to 10	1
10 to 11	1
11 to 12	0
12 to 13	1
13 to 14	0
14 to 15	1
15 to 16	0
16 to 17	1
17 to 18	0
18 to 19	0
19 to 20	0
20 to 21	1

Another consideration in interpreting wave period for the band with maximum energy in the spectrum arises from peculiarities of the wind-wave generation process (Barnett, 1972; Hasselmann, et al., 1973). Nonlinear transfer of wave energy between different frequencies during wave generation causes a net gain of energy in the low-frequency part of the spectrum. The energy transfer process also focuses most of the energy into an increasingly narrow band of frequencies.

Waves traveling away from a generation area tend to segregate according to frequency as low-frequency waves move faster than high-frequency waves. The low-frequency waves also attenuate more slowly than the high-frequency waves.

Thus, wave conditions can arise where a train of low-frequency waves provides the maximum energy in any single spectral band; a train of higher frequency waves contains more total energy but the energy is spread over several frequency bands. In such conditions, the standard analysis would report the period of the low-frequency waves.

VI. COMPARISON OF RESULTS FROM SIMULTANEOUS DIGITAL AND PEN AND INK RECORDS

1. Introduction.

BEB-CERC accumulated a large volume of significant wave heights and periods obtained from pen and ink records. CERC is now in the process

of accumulating and analyzing a considerable number of digital wave records. Both of these data files represent a large investment of money and effort, and provide valuable documentation of waves at many U.S. coastal locations.

In using significant heights and periods from both pen and ink and digital records in this study, the derivation is sometimes ignored; however, this approach can be misleading. Pen and ink record analyses can depend on the method used to obtain them. With data recorded and analyzed by two totally different procedures, discrepancies in the analyses are even more likely.

Engineers are more familiar with pen and ink records because these records have been available longer than digital records. Does the engineer need to make special allowances when using heights and periods derived from digital records? This question is best answered by the following specific questions:

(1) How do individual significant height and period estimates from pen and ink records compare with those from digital records taken at about the same time?

(2) How do statistics such as mean and standard deviation of the distribution functions compare?

(3) How do the distribution functions compare?

These questions are discussed in this section; conclusions are briefly summarized at the end of the section.

2. Description of Data Sample.

To investigate the compatibility of significant wave heights and periods from digital and pen and ink records, an 8-month sample of both types of data, taken between September 1971 and April 1972, has been analyzed. The digital data (discussed in Section V) were 1,024-second records taken four times daily from gages at six Atlantic coast and two gulf coast locations; 7-minute pen and ink records were also taken four times daily from the same locations, each record beginning within 30 minutes of a digital record. Pen and ink records were then analyzed by the CERC method (Section IV, 2).

3. Comparison of Results.

a. Individual Estimates.

(1) Significant Height. Significant height estimates from digital and pen and ink records taken at an Atlantic coast gage location (Savannah Light Tower, Georgia) are compared in Table 2. The table is a joint distribution of the ratio of pen and ink height estimate to digital height estimate as a function of digital height estimate.

Table 2. Comparison of significant wave height estimates from digital and pen and ink records, Savannah Light Tower, Georgia, September 1971 to April 1972.

H(Pi) ² H(Digital) ³	H(Digital) in feet								Total ⁴	Cumulative totals ⁵	Row average ⁶
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8			
0.0 to 0.1											
0.1 to 0.2											
0.2 to 0.3											
0.3 to 0.4											
0.4 to 0.5		17									
0.5 to 0.6		3	1	1					1	499	1.50
0.6 to 0.7		4	7	3	3				5	498	2.10
0.7 to 0.8		3	5	2	2	1	1		17	493	2.79
0.8 to 0.9		18	60	19	8	4	3	1	14	476	3.21
0.9 to 1.0		8	36	41	21	7	4		113	462	2.91
1.0 to 1.1		1	54	39	31	12	4	1	117	349	3.46
1.1 to 1.2		3	18	19	11	4	1		142	232	3.61
1.2 to 1.3			14	5	7				56	90	3.46
1.3 to 1.4		3	3	1					26	34	3.23
1.4 to 1.5			1						7	8	2.21
Total ⁸	44	199	455	256	83	28	13	2	1	1	2.50
Cumulative total ¹⁰	499	455	455	256	126	43	15	2			3.309
Average ¹¹	0.873	0.977	0.977	0.996	1.014	1.000	0.958	0.950	0.980		
Percent in 1.0 ± 0.1 ¹²	20	45	45	62	63	68	62	50	52 ¹³		

¹Estimates taken within 30 minutes of each other; total of 499 observations.

²H(Pi) = Significant height in feet from pen and ink records by the CERC method (see App. B).

³H(Digital) = Four times the standard deviation of the digital record.

⁴Total number of cases in specified height ratio intervals.

⁵Cumulative total of the total number of cases in specified height ratio intervals.

⁶Average digital height estimate for all cases in specified height ratio intervals; indicates if certain height ratios tend to associate with high or low wave conditions.

⁷Number of times the height estimate ratio and the digital height estimate falls within the specified intervals.

⁸Total number of cases in specified digital estimate intervals.

⁹Average digital height estimate for all 499 observations.

¹⁰Cumulative total of the total number of cases in specified digital estimate intervals.

¹¹Average height ratio for all cases in specified digital height intervals; indicates if certain wave height levels tend to associate with high or low wave height ratios.

¹²Percentage of cases in each digital height interval in which height estimates were within 10 percent of each other.

¹³Percentage of all 499 observations with height ratios between 0.9 and 1.1.

Over half of the pen and ink estimates in Table 2 are within ± 10 percent of the corresponding digital estimates; however, a few height ratios are substantially different from unity. Seven of the pen and ink estimates differ from the digital estimates by more than ± 40 percent. The table shows a decrease in percentage variability of pen and ink estimates for higher wave conditions, indicating that the dispersion between estimates may be absolute rather than wave height dependent.

Table 2 shows no consistent tendency for pen and ink height estimates to fall above or below digital estimates; the average pen and ink height estimate was 98 percent of the average digital height estimate. This difference in averages amounts to only 0.05 foot.

Comparisons of height estimates from seven other gage locations lead to the following similar conclusions: (a) About half of the digital and pen and ink estimates agree within ± 10 percent, (b) 4 out of 100 estimates can differ by ± 40 percent or more, and (c) percentage variability of estimates decreases with increasing wave height.

Correlations between estimates in the full 8-month data sample (Table 3) also indicate that, in general, individual significant height estimates compare favorably (between 0.93 and 0.96 for every location). Correlations between digital and pen and ink height estimates obtained by Harris (1970), using the same methods for two 1-month data samples from Atlantic City, New Jersey, also fall within this range.

For high wave conditions at some locations, the pen and ink height estimates tend to be relatively high; e.g., Wrightsville Beach, North Carolina (Table 4). This tendency derives from the nonlinear wave shapes characteristic of high, long waves in shallow water (see Fig. 10). In the analysis of the pen and ink record in Figure 10, individual wave heights were measured as the difference between crest and preceding trough elevations. The wave height estimate from the corresponding digital record is based on the total potential energy in the record. For a record with sharp crests and flat troughs, the energy in each wave is considerably less than that in a sinusoidal wave of the same height (Fig. 11). The pen and ink height estimate is over 2 feet higher than the digital estimate for the record shown in Figure 10.

Pen and ink height estimates are based on 7-minute records; digital estimates are based on records nearly 2.5 times as long. Since high waves sometimes occur in groups (Rye, 1974), height estimates from the shorter 7-minute records can be unrepresentatively high or low due to poor statistical sampling.

Although height estimates derived from pen and ink records of high, long waves in shallow water tend to be excessive, the reverse would be true for purely sinusoidal waves of uniform height. Ideally, this pen and ink height estimate would be the height of the waves. The digital estimate would be four times the standard deviation or 1.414 times the individual wave height. Thus, the pen and ink estimate would be 30

Table 3. Correlation between significant wave estimate from digital and pen and ink records taken during September 1971 to April 1972.¹

Location	Height estimates		Period estimates	
	No.	Correlation between estimates	No.	Correlation between estimates
Chesapeake Bay-Bridge Tunnel, Va.	738	0.96	627	0.47
Nags Head, N.C.	649	0.96	694	0.73
Wrightsville Beach, N.C.	764	0.96	755	0.68
Holden, N.C.	698	0.93	675	0.73
Savannah Light, Ga.	499	0.94	499	0.61
Daytona Beach, Fla. ²	714	0.96	705	0.71
Naples, Fla.	297	0.94	203	0.75
Destin, Fla.	624	0.96	544	0.79

¹Digital and pen and ink records were taken within 30 minutes of each other.

²Digital estimates were not compensated for hydrodynamic attenuation due to submergence of the gage (7 feet below MSL).

Table 4. Comparison of significant wave height estimate from digital and pen and ink records at Wrightsville Beach, North Carolina, September 1971 to April 1972¹.

H(P) ² H(Digital) ³	H(Digital) in feet										Total ⁴	Cumulative totals ⁵	Row average ⁶
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10			
0.0 to 0.1	4	17									5	760	0.70
0.1 to 0.2													
0.2 to 0.3			2								2	755	2.50
0.3 to 0.4		1	1								2	753	2.00
0.4 to 0.5		9	2								11	751	1.68
0.5 to 0.6		8	8								16	740	2.00
0.6 to 0.7		12	11								26	724	2.04
0.7 to 0.8	1	6	33	2	1						77	698	2.07
0.8 to 0.9	6	30	59	39	6	1					158	621	2.54
0.9 to 1.0	1	41	127	44	30	5	1				250	463	2.84
1.0 to 1.1		13	60	41	22	9	2				147	213	3.24
1.1 to 1.2		11	21	12	5	1					51	66	2.89
1.2 to 1.3		4	2	1	2	1	1			1	12	15	3.83
1.3 to 1.4											2	3	2.50
1.4 to 1.5											1	1	3.50
1.5 to 1.6													
Total ⁸	12	182	327	148	66	17	3	3	1	1			2.72 ⁹
Cumulative total ¹⁰	760	748	566	239	91	25	8	5	2	1			
Average ¹¹	0.592	0.943	1.017	1.061	1.095	1.126	1.117	1.117	1.250	1.350	1.012		
Percent in 1.0 ± 0.1 ¹²	8	51	57	56	55	35	67	33	0	0	54 ¹³		

¹Taken within 30 minutes of each other; total of 760 observations.

²H(P) = Significant height in feet derived from pen and ink records by the CERC method (App. B).

³H(Digital) = Four times the standard deviation of the digital record.

⁴Total number of cases in specified height ratio intervals.

⁵Cumulative total of the total number of cases in specified height ratio intervals.

⁶Average digital height estimate for all cases in specified height ratio intervals; indicates if certain height ratios tend to associate with high or low wave conditions.

⁷Number of times the height estimate ratio and the digital height estimate falls within the specified intervals.

⁸Total number of cases in specified digital estimate intervals.

⁹Average digital height estimate for all 760 observations.

¹⁰Cumulative total of the total number of cases in specified digital estimate intervals.

¹¹Average height ratio for all cases in specified digital height intervals; indicates if certain wave height levels tend to associate with high or low wave height ratios.

¹²Percentage of cases in each digital height interval in which height estimates were within 10 percent of each other.

¹³Percentage of all 760 observations with height ratios between 0.9 and 1.1.

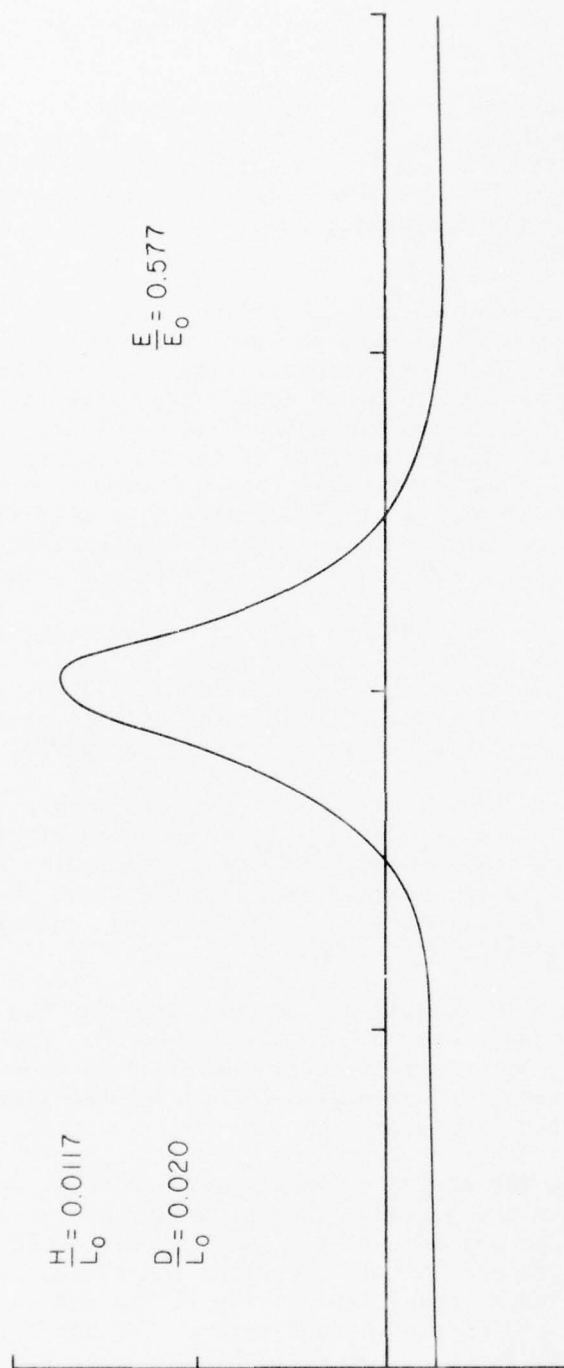


Figure 11. Shallow-water wave profile for $H/L_0 = 0.0117$ and $D/L_0 = 0.010$ (H = wave height, L_0 = deepwater wavelength, and D = water depth). The energy in this wave is equal to 58 percent of the energy in a sinusoidal wave of the same height (Dean, 1974).

percent less than the digital estimate for a purely sinusoidal wave. In practice, when wave conditions indicate relatively uniform heights and approximately sinusoidal waveforms, the digital height estimate may be higher than the pen and ink estimate (Fig. 12).

When wave conditions are nearly calm, the recorded wave heights fall within a very small height range. The waves have a nearly uniform height and their shape is often more nearly sinusoidal than the shape of high waves in shallow water (Fig. 10). Therefore, for very low wave conditions, the pen and ink height estimate tends to be lower than the digital estimate (see Tables 2 and 4).

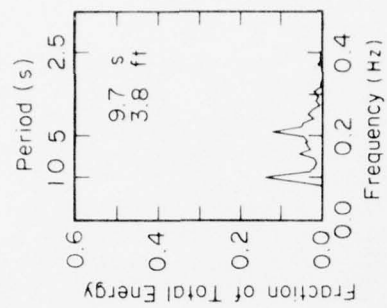
Both the digital and the pen and ink record analysis methods have peculiarities in dealing with records of low wave conditions. The digital analysis is designed to reject spectral calculations when the significant height estimate is less than 0.4 foot. The convention for pen and ink record analysis is to report "calm +" if waves are between 0.5 and 1 foot high, and for summarization to assign a significant height estimate of 0.7 foot. If waves are less than 0.5 foot high, the pen and ink analysis reports "calm" which is counted as a significant height estimate of 0. These peculiarities are generally unimportant except for records from a few locations where calms are relatively common.

(2) Wave Period. Wave period estimates from digital and pen and ink records taken at Savannah Light Tower, Georgia, are compared in Table 5. The table gives the joint distribution of digital period estimate versus pen and ink period estimate; the dashline indicates the points at which digital and pen and ink estimates agree.

Most period estimates are within 1 second of each other, which is reasonable agreement considering the approximate method of determining wave period from pen and ink records. In some records, the period estimates differ considerably. The general agreement and the occasional large differences between estimates in Table 5 are typical of the records from seven other gage locations.

Correlations between individual period estimates for the full 8-month data sample are lower than those for heights (Table 3). Except for the gage in Chesapeake Bay, correlations range between 0.61 and 0.79. Comparable correlations were found by Harris (1970) for two 1-month data samples from the Atlantic City gage.

In several records, the period estimates were quite different. A pen and ink record where the period estimates differ by 10 seconds is shown in Figure 13. Each period in the figure appears to be associated with a different wave train. In this situation the trains have comparable wave heights, and a technician looking at the pen and ink record usually reports the period of the shorter waves. The short length of pen and ink records also limits a technician from identifying a long-period pattern in the waves when both short-period energy and long-period energy are present.



Data Type	Significant Height (ft)	Wave Period (s)
Pen and Ink	3.5	6.0
Digital	3.8	9.7

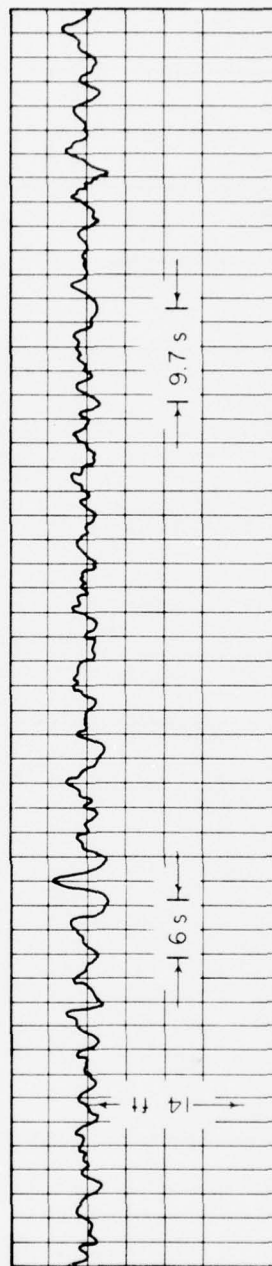


Figure 12. Example of wave record from Savannah Light Tower, Georgia, at 0720 hours, 29 May 1972.

Table 5. Comparison of wave period estimates from digital and pen and ink records, Savannah Light Tower, Georgia, September 1971 to April 1972¹.

T(Digital) ² in seconds		T(Pi) ³ in seconds													Total ⁴	Cumulative Total ⁵	Row average ⁶
0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13					

¹Taken within 30 minutes of each other; total of 499 observations.

²T(Digital) = Period corresponding to frequency of highest peak in energy spectrum.

³T(Pi) = Significant period derived from pen and ink records by the CERC method.

⁴Total number of cases in specified digital estimate intervals.

⁵Cumulative total of the total number of cases in specified digital estimate intervals.

⁶Average pen and ink period estimate for all cases in specified digital estimate intervals.

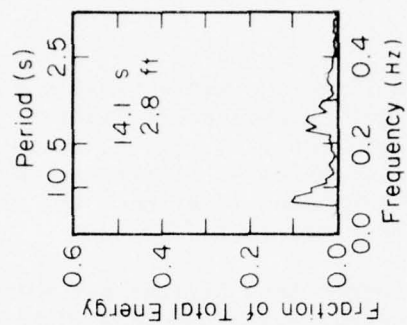
⁷Number of times the digital and pen and ink period estimates fall within the specified intervals.

⁸Total number of cases in specified pen and ink estimate intervals.

⁹Average pen and ink estimate for all 499 observations.

¹⁰Cumulative total of the total number of cases in specified pen and ink estimate intervals.

¹¹Average digital period estimate for all cases in specified pen and ink estimate intervals.



Data Type	Significant Height (ft)	Wave Period (s)
Pen and Ink	2.5	4.0
Digital	2.8	14.1

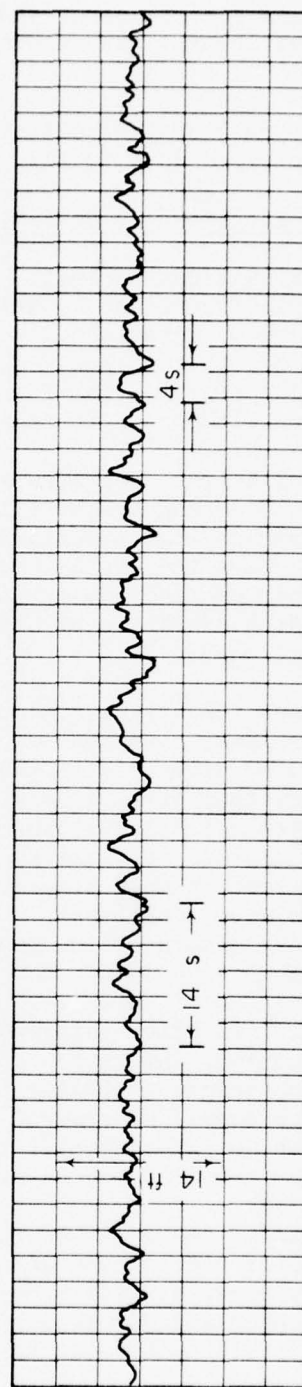


Figure 13. Example of wave record from Savannah Light Tower, Georgia, at 0042 hours, 22 September 1971.

Another pen and ink record (Fig. 14) shows a wave period estimate of 6 seconds and a corresponding digital estimate of 4.5 seconds. Again, the presence of several wave trains appears to be responsible for the discrepancy.

Therefore, much of the scatter in Table 5 can be attributed to the presence of multiple wave trains.

b. Means and Standard Deviations.

(1) Significant Height. Significant height estimates for the full data sample from eight locations are summarized in Table 6. Except for estimates from Chesapeake Bay Bridge-Tunnel, Virginia, and Naples, Florida, mean digital and pen and ink estimates of significant height agree within 10 percent. For four of the seven locations, the mean estimates agree within 4 percent or about 0.1 foot.

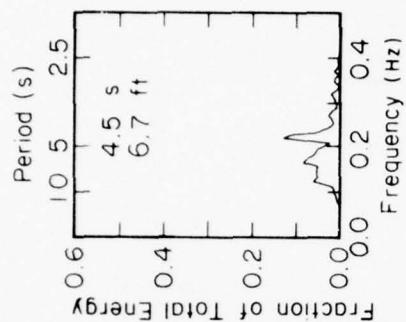
Pen and ink height estimates are larger than digital estimates for data from Nags Head and Wrightsville Beach, North Carolina (Table 6). Except for Savannah Light, Georgia, in significantly deeper water, these locations also have the highest mean wave conditions. Thus, the tendency for higher pen and ink estimates is believed due to the nonlinear wave shapes often exhibited by high waves in shallow water as discussed earlier in Section VI, 3,a.

Mean pen and ink height estimates from Chesapeake Bay Bridge-Tunnel and Naples are lower than mean digital estimates (Table 6). The differences are related primarily to the frequent occurrence of relatively calm wave conditions at both locations. For individual pen and ink height estimates which are less than 1 foot, the estimate is usually less than the digital estimate as discussed earlier in Section IV, 3,a. The effect is seen on mean significant height at a location with frequent very low wave conditions. Holden Beach, North Carolina, and Destin, Florida, also have low mean heights, but seldom experience calm conditions.

The engineer is often interested in monthly or seasonal wave conditions at a location. Since the relationship between monthly mean digital and pen and ink height estimates is more variable than mean estimates based on a data sample of several months, the maximum observed difference in monthly mean height estimates for each location is included in Table 6. Most of the maximum differences are less than 20 percent.

Another useful statistic of the distribution function is the standard deviation of significant heights. It is the most important parameter in a simple exponential model of the cumulative distribution function (Thompson and Harris 1972; Harris 1972b; U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, p. 4-35).

The standard deviation of digital significant height estimates and the percentage difference between standard deviations of the digital



Data Type	Significant Height (ft)	Wave Period (s)
Pen and Ink	7.0	6.0
Digital	6.6	4.5

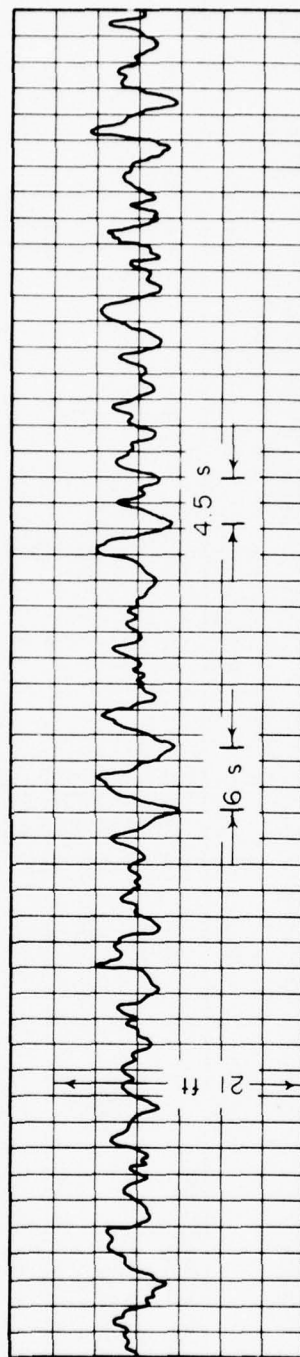


Figure 14. Example of wave record from Savannah Light Tower, Georgia, at 0120 hours, 27 May 1972.

Table 6. Comparison of significant wave height statistics from digital and pen and ink records taken during September 1971 to April 1972¹.

Location	Months (No.)	Observation (No.)	\bar{H}_{DIG} (ft)	$\left(\frac{\bar{H}_{PI}}{\bar{H}_{DIG}} - 1\right) \times 100$ (pct)	Maximum difference in monthly mean height ⁴ (pct of \bar{H}_{DIG})	σ_{DIG} (ft)	$\left(\frac{\sigma_{PI}}{\sigma_{DIG}} - 1\right) \times 100$ (pct)
Chesapeake Bay-Bridge Tunnel, Va.	8	738	1.99	-12.6	-19	1.24	+19
Nags Head, N.C.	8	694	3.46	+ 8.7	+14	1.76	+24
Wrightsville Beach, N.C.	8	764	2.65	+ 3.8	+10	1.09	+26
Holden Beach, N.C.	8	698	1.97	0	+ 5	0.86	+21
Savannah Light, Ga.	5	499	3.24	- 1.5	- 5	1.18	+ 9
Daytona Beach, Fla. ⁷	8	714	1.00	-18.0	-21	1.00	+17
Naples, Fla.	5	297	1.65	+ 1.2	-14	0.58	+33
Destin, Fla.	7	624	1.65	+ 1.2	-14	1.02	+23

¹Digital and pen and ink records were taken within 30 minutes of each other.

² \bar{H}_{DIG} is mean significant height estimate from digital records.

³ \bar{H}_{PI} is mean significant height estimate from pen and ink records.

⁴Months with 70 or more observations were considered.

⁵ σ_{DIG} is standard deviation of significant height estimates from digital records.

⁶ σ_{PI} is standard deviation of significant height estimates from pen and ink records.

⁷Digital estimates were not compensated for hydrodynamic attenuation due to submergence of the gage.

and pen and ink height estimates for each location are included in Table 6. Standard deviations of the pen and ink estimates are between 9 and 33 percent greater in every estimate.

Standard deviations of pen and ink height estimates are high because each estimate is based on only a few of the higher waves in a 7-minute record; each digital estimate is based on a full 1,024-second record. Thus, the pen and ink estimates would be expected to show more scatter, and also the tendency for pen and ink estimates to be relatively high for high waves in shallow water leads to larger standard deviations of the estimates.

(2) Wave Period. Wave period estimates for all eight locations are summarized in Table 7. At each location, the mean pen and ink estimate is lower than the mean digital estimate; however, the differences are small, about one-half a second or less.

Differences between observed monthly mean period estimates are greater, although the pen and ink estimates are never more than 1 second or 15 percent less than the digital estimates. This tendency for pen and ink period estimates to be lower than digital estimates was discussed previously.

The standard deviation of wave period estimates at each location (Table 7) is between 6 and 40 percent smaller for pen and ink estimates than for digital estimates.

c. Distribution Functions. Since many engineering applications of wave data require a distribution function giving the frequency of occurrence of height or period estimates in specified intervals, a comparison of distribution functions from digital and pen and ink estimates is warranted.

Distribution functions of significant height estimates for two locations are plotted in Figure 15. The figure shows that the pen and ink analysis gives more height estimates in the highest intervals of the distribution function, as expected from previous discussion of high waves in shallow water (a characteristic which is particularly noticeable for Wrightsville Beach in Fig. 15,b).

The pen and ink analysis also gives an excessive number of heights in the lowest interval of the distribution function. This characteristic can be attributed to the instructions for the record analysis which state that records with all waves lower than 1 foot be reported as "calm +" or "calm". Since this procedure is simpler than that for records with waves higher than 1 foot, the analyzer tends to facilitate the job by reporting marginal cases as "calm +".

The situation is reversed for wave period estimates. Digital period estimates are more common than pen and ink estimates at both the high and low ends of the distribution function (Fig. 16). Discontinuities

Table 7. Comparison of wave period statistics from digital and pen and ink records taken during September 1971 to August 1972¹.

Location	Months (No.)	Observation (No.)	² \bar{T}_{DIG} (s)	³ $\left(\frac{\bar{T}_{PI}}{\bar{T}_{DIG}} - 1\right) \times 100$ (pct)	Maximum difference in monthly mean period ⁴ (pct of \bar{T}_{DIG})	⁵ σ_{DIG} (s)	⁶ $\left(\frac{\sigma_{PI}}{\sigma_{DIG}} - 1\right) \times 100$ (pct)
Chesapeake Bay-Bridge Tunnel, Va.	8	627	3.7	-11.1	-15	1.46	-40
Nags Head, N.C.	8	694	8.7	-5.0	-10	2.53	-12
Wrightsville Beach, N.C.	8	755	7.8	-5.4	-9	2.50	-16
Holden Beach, N.C.	8	675	7.6	-6.3	-8	2.52	-22
Savannah Light, Ga.	5	499	6.8	-7.2	-14	2.67	-24
Daytona Beach, Fla. ⁷	8	705	9.4	-4.0	-6	2.34	-25
Naples, Fla.	5	203	4.9	-12.7	---8	1.99	-15
Destin, Fla.	7	544	5.8	-2.1	-4	1.55	-6

¹Digital and pen and ink records were taken within 30 minutes of each other.

² \bar{T}_{DIG} is mean wave period estimate from digital records.

³ \bar{T}_{PI} is mean wave period estimate from pen and ink records.

⁴Months with 70 or more observations were considered.

⁵ σ_{DIG} is standard deviation of wave period estimates from digital records.

⁶ σ_{PI} is standard deviation of wave period estimates from pen and ink records.

⁷Digital estimates were not compensated for hydrodynamic attenuation due to submergence of the gage.

⁸No months with 70 or more observations available.

Data Type	Mean Significant Height (ft)	Standard Deviation of Significant Height (ft)
Pen and Ink	3.19	1.29
Digital	3.24	1.18

Data Type	Mean Significant Height (ft)	Standard Deviation of Significant Height (ft)
Pen and Ink	2.75	1.37
Digital	2.65	1.09

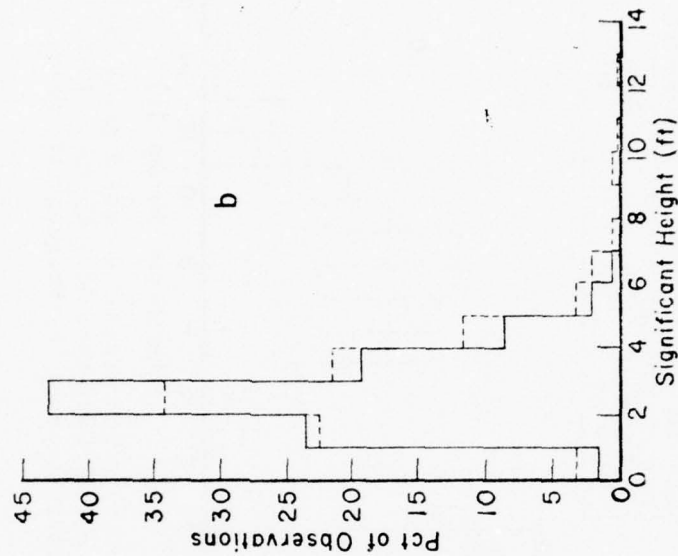
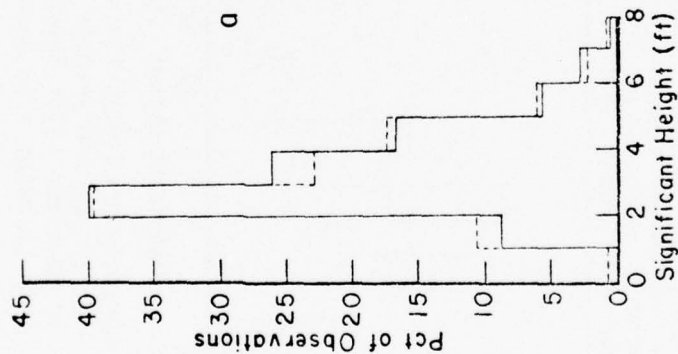


Figure 15. Comparison of distribution functions of significant wave height estimated from digital (solid line) and pen and ink records (dashed line) taken during September 1971 to April 1972. (a) Savannah Light Tower, Georgia (499 observations); (b) Wrightsville Beach, North Carolina (764 observations).

Data Type	Mean Period (s)	Standard Deviation of Period (s)
Pen and Ink	6.3	2.0
Digital	6.8	2.7

Data Type	Mean Period (s)	Standard Deviation of Period (s)
Pen and Ink	7.4	2.1
Digital	7.8	2.5

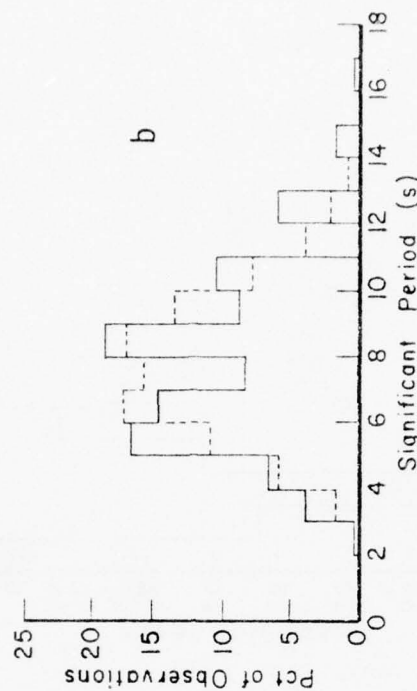
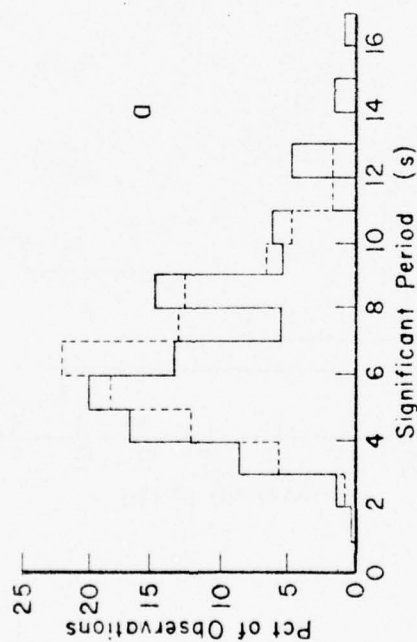


Figure 16. Comparison of distribution functions of wave period estimated from digital (solid line) and pen and ink records (dashed line) taken during September 1971 to April 1972. (a) Savannah Light Tower, Georgia (499 observations); (b) Wrightsville Beach, North Carolina (755 observations).

in the distribution functions for digital estimates are due to the low resolution of the digital analysis for long wave periods (see Section V).

The tendency of pen and ink period estimates to be shorter than digital estimates was discussed earlier in this section (VI, 3,a). The scarcity of pen and ink estimates at the other end of the distribution function is partially due to the subjectivity of the analysis. Since multiple wave trains are common, a technician analyzing pen and ink records often has several alternative wave periods to report, and when given a choice, usually favors wave periods close to the overall mean.

4. Summary of Comparisons between Simultaneous Digital and Pen and Ink Records.

Comparisons of digital and pen and ink records taken within 30 minutes of each other are summarized below.

(a) Individual significant wave height estimates agree within ± 10 percent one-half the time, but occasionally differ by ± 40 percent or more.

(b) Individual wave period estimates generally agree within ± 1 second, but can differ by 10 seconds if several wave trains are present.

(c) Mean significant height estimates generally agree within 10 percent or less; standard deviations of height estimates based on pen and ink data are about 20 percent greater than those based on digital data.

(d) Mean wave period estimates from pen and ink data are about 10 percent less than period estimates from digital data; standard deviations are about 20 percent smaller than those based on digital data.

(e) Pen and ink estimates generally give more heights at the upper and lower extremes than digital estimates.

(f) Pen and ink estimates generally give fewer periods at the upper and lower extremes than digital estimates.

VII. COMPARISON OF WAVE CLIMATE FROM DIGITAL AND PEN AND INK RECORDS

Although digital and pen and ink wave records taken within 30 minutes of each other during an 8-month period generally give comparable estimates of significant wave height and period, it is also important to compare wave climate determined from a large sample of both types of data. If these data indicate basically the same wave climate at locations where both types are available, both digital and pen and ink estimates can be used with confidence in determining wave climate at other locations.

Thompson and Harris (1972) showed that the cumulative distribution function of significant wave height for a full year of data is generally characteristic of a location for the lower 99 percent of the significant waves. This is supported by the more recent and complete years of data included in Appendix A. Large wave heights can vary from year to year; however, except for extremes, a year of data will provide a good sampling of local meteorological conditions and the waves they generate. Thompson and Harris also indicated that the annual distribution function of significant height is independent of the time of day when the data were collected. Thus, to check the climatological validity of significant height estimates, annual summaries are desirable.

Annual means and standard deviations of significant height estimates are plotted in Figure 17 for most reasonably complete years of data included in Appendix A. Most differences between annual mean significant height estimates for the same data type from different years are as great as differences between annual means for different data types. Except for Huntington Beach, California, estimates of annual mean significant height are within about 30 percent or 1 foot of each other, and differences at most locations can be attributed to annual variability in wave conditions. The pen and ink estimates for Huntington Beach differ substantially from the digital estimates due to the old design of the gage at Huntington Beach before July 1969 and to the difficulty of maintaining a gage located so far from BEB-CERC.

Most annual standard deviations of significant height estimates from digital and pen and ink data compare favorably (Fig. 17).

Annual means and standard deviations of significant period estimates are plotted in Figure 18. Annual mean pen and ink period estimates are slightly lower than the digital estimates, although both estimates are generally within 15 percent or 1 second of each other. Standard deviations of period estimates are also comparable, generally differing by less than 30 percent.

Annual distribution functions of significant height estimates can conveniently be compared when plotted in a semilog format (Thompson and Harris, 1972; Harris, 1972b). BEB-CERC data for seven different locations are sufficient to permit such comparisons between digital and pen and ink estimates. The comparisons are best illustrated in Appendix A which summarizes data from Atlantic City, New Jersey, Virginia Beach, Virginia, Nags Head, North Carolina, Naples, Florida, and Huntington Beach, California. Data in the appendix for each of these locations show that, for the more recent and complete years of data, the annual variability in the distribution function of significant height estimates from one data type is as great as the variations between distribution functions from different data types. For Huntington Beach, the distribution functions from digital data are higher than distribution functions from pen and ink data for reasons noted earlier in this section.

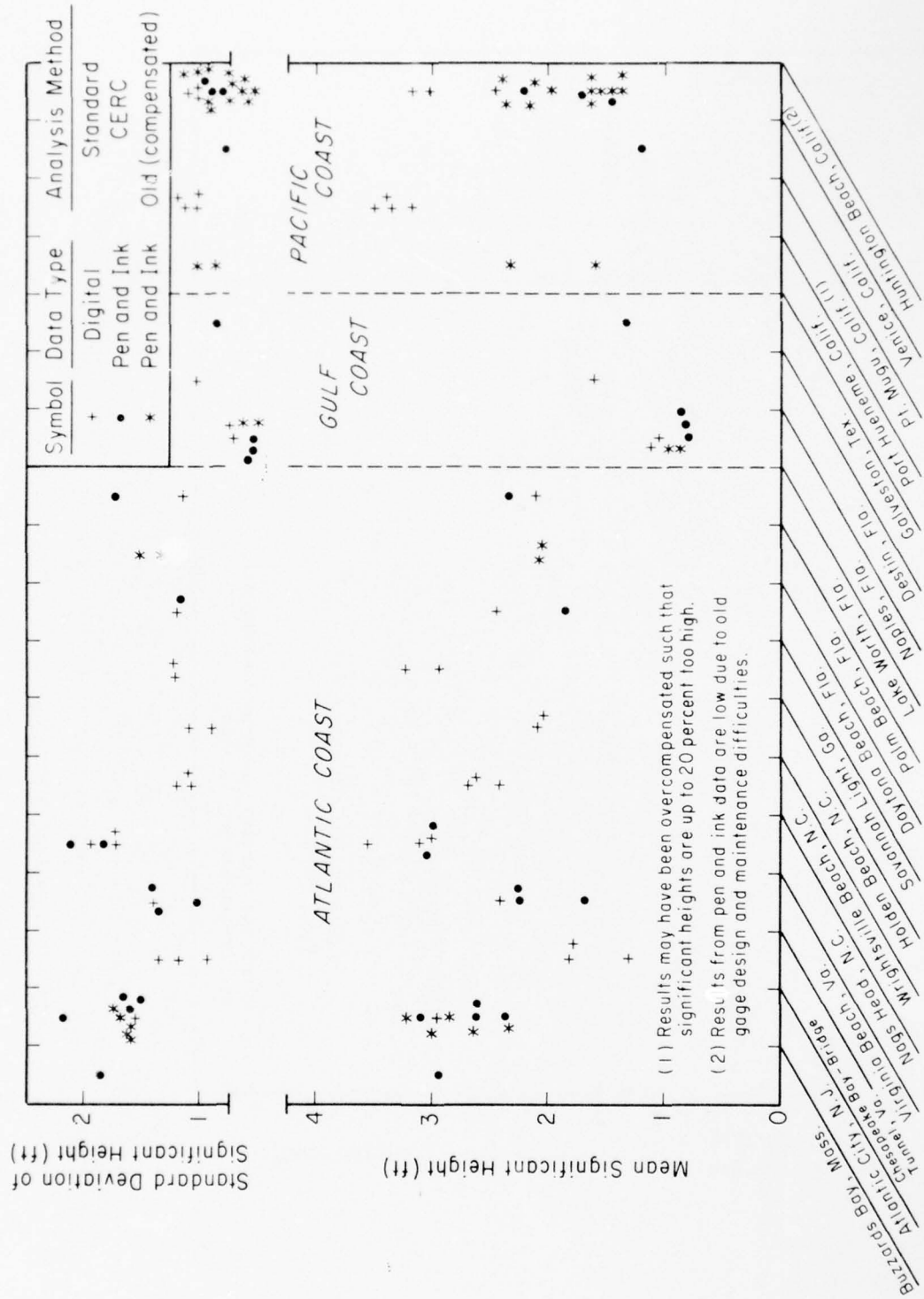


Figure 17. Annual means and standard deviations of significant wave height from 19 gage locations.

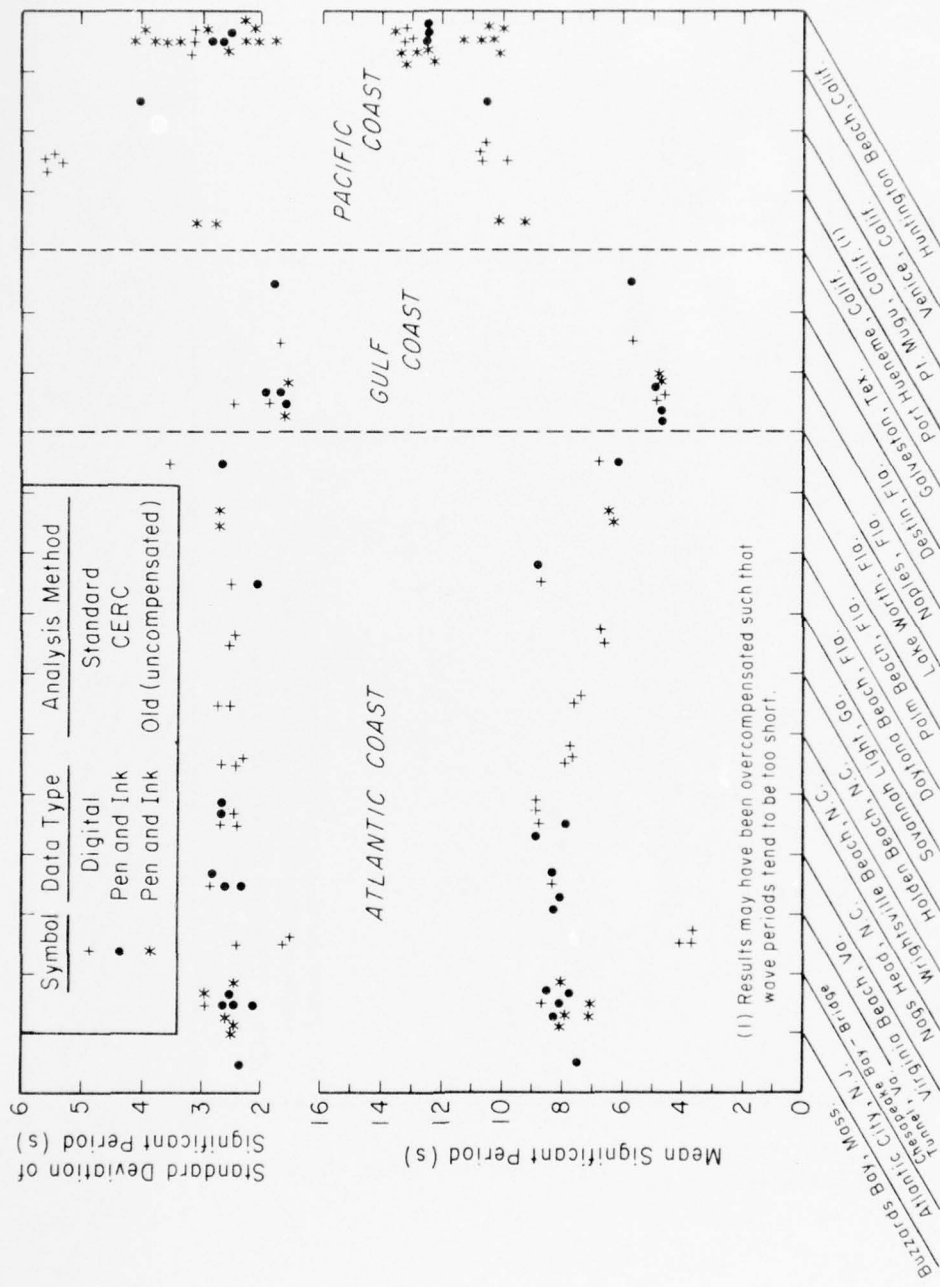


Figure 18. Annual means and standard deviations of significant wave period from 19 gage locations.

Annual probability density functions of wave period estimates indicate reasonable consistency between digital and pen and ink estimates. The comparison is shown by simple bar graphs in Appendix A for the above five gage locations and for Daytona Beach and Lake Worth, Florida. The peak density for all seven locations occurs in the same or an adjacent period interval for both digital and pen and ink estimates.

LITERATURE CITED

- BARNETT, T.P., "Observations of Wind Wave Generation and Dissipation in the North Sea: Implications for the Offshore Industry," *Proceedings of the Offshore Technology Conference*, Dallas, Tex., May 1972, pp. 43-50.
- BINGHAM, C., GODFREY, M.D., AND TUKEY, J.W., "Modern Techniques of Power Spectrum Estimation," *The Institute of Electrical and Electronics Engineers Transactions on Audio and Electroacoustics*, AU-15, 1967, pp. 56-66.
- BRISCOE, M.G., "Energy Loss in Surface Wave Spectra Due to Data Windowing," *Deep-Sea Research*, Vol. 19, 1972, pp. 665-667.
- DEAN, R.G., "Evaluation and Development of Water Wave Theories for Engineering Application," SR-1, Vol. I, Stock No. 008-022-00083, Vol. II, Stock No. 008-022-00084, U.S. Government Printing Office, Washington, D.C., Nov. 1974.
- ESTEVA, D., and HARRIS, D.L., "Comparison of Pressure and Staff Wave Gage Records," *Proceedings of the 12th Coastal Engineering Conference*, Washington, D.C., 1970, pp. 101-116.
- GALVIN, C.J., Jr., "Wave Breaking in Shallow Water," *Waves on Beaches and Resulting Sediment Transport*, Academic Press, New York, Mar. 1972, pp. 413-456.
- HARRIS, D.L., "The Analysis of Wave Records," *Proceedings of the 12th Coastal Engineering Conference*, Washington, D.C., 1970, pp. 85-100.
- HARRIS, D.L., "Characteristics of Wave Records in the Coastal Zone," *Waves on Beaches and Resulting Sediment Transport*, Academic Press, New York, 1972a, pp. 35-40.
- HARRIS, D.L., "Wave Estimates for Coastal Regions," *Shelf Sediment Transport*, Dowden, Hutchinson, and Ross, Stroudsburg, Pa., 1972b, pp. 99-125.
- HARRIS, D.L., "Finite Spectrum Analyses of Wave Records," *Proceedings, International Symposium on Ocean Wave Measurement and Analysis*, New Orleans, La., 1974, pp. 107-124.
- HASSELMANN, K., et al., "Measurement of Wind-Wave Growth and Swell Decay During the Joint North Sea Wave Project (JONSWAP)," Deutsches Hydrographisches Institut, Hamburg, 1973.
- McCLENAN, C.M., and HARRIS, D.L., "The Use of Aerial Photography in the Study of Wave Characteristics in the Coastal Zone," TM-48, U.S. Army, Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, Va., Jan. 1975.

- PEACOCK, H.G., "Remote Wave Gaging Program," *Proceedings, International Symposium on Ocean Wave Measurement and Analysis*, New Orleans, La., 1974, pp. 170-185.
- RYE, H., "Wave Group Formation Among Storm Waves," *Proceedings of the 14th Coastal Engineering Conference*, Copenhagen, Denmark, 1974, pp. 164-183.
- SEYMOUR, R.J., et al., "Coastal Engineering Data Network," First Semi-Annual Report, Institute of Marine Resources, University of California, La Jolla, Calif., 1976.
- SVERDRUP, H.U., and MUNK, W.H., "Empirical and Theoretical Relations Between Wind, Sea, and Swell," *Transactions, American Geophysical Union*, Vol. 27, No. 6, 1946, pp. 823-827.
- THOMPSON, E.F., and HARRIS, D.L., "A Wave Climatology for U.S. Coastal Waters," *Proceedings of Offshore Technology Conference*, Dallas, Tex., May 1972, pp. 675-688.
- THOMPSON, E., "Results from the CERC Wave Measurement Program," *Proceedings of the International Symposium on Ocean Wave Measurement and Analysis*, New Orleans, La., Sept. 1974, pp. 836-855.
- TUCKER, M.J., "Simple Measurement of Wave Records," *The Dock and Harbor Authority*, Vol. XLII, No. 493, Nov. 1961, p. 231.
- TUKEY, J.W., "An Introduction to the Calculations of Numerical Spectrum Analysis," *Advanced Seminar on Spectral Analysis of Time Series*, Wiley and Sons, New York, 1967, pp. 25-46.
- U.S. ARMY, CORPS OF ENGINEERS, COASTAL ENGINEERING RESEARCH CENTER, *Shore Protection Manual*, 2d ed., Vols. I, II, and III, Stock No. 008-022-00077, U.S. Government Printing Office, Washington, D.C., 1975, 1,160 pp.
- WILLIAMS, L.C., "CERC Wave Gages," TM-30, U.S. Army, Corps of Engineers, Coastal Engineering Research Center, Washington, D.C., Dec. 1969.
- WILSON, J.R., and BAIRD, W., "A Discussion of Some Measured Wave Data," *Proceedings of the 13th Coastal Engineering Conference*, Vol. 1, 1972.

APPENDIX A

EXPLANATION OF SUMMARIES OF SIGNIFICANT HEIGHT AND PERIOD

1. General Format of Summaries.

Significant heights and periods are summarized in Appendixes A-1 (U.S. Atlantic coast gages), A-2 (gulf coast gages), and A-3 (Pacific coast gages). Each appendix includes a map showing gage locations. The data summaries are ordered according to gage location, from north to south for the oceanic coasts and from east to west for the gulf coast.

The following data are included in the summaries for each location:

- (a) Gage history;
- (b) number of records analyzed for each month and year;
- (c) plot of monthly maxima, means, and standard deviations of significant height;
- (d) plot of monthly means and standard deviations of significant period;
- (e) plot of annual significant height distribution functions;
- (f) plot of annual significant period distribution functions;
- (g) plot of seasonal significant height distribution functions; and
- (h) seasonal and total joint distribution functions of significant height versus period.

2. Explanation of Summary Formats.

a. Gage Histories. A tabular history of the wave gage or gages which acquired the data is included in the summaries. The history includes pertinent physical information about the gage, the gage supporting structure, and dates for wave records obtained with no continuous interruptions longer than 1 month. Some of the interruptions are documented and explained, but many short interruptions in the recording sequence are not mentioned.

b. Number of Analyzed Records. The number of analyzed wave records available for each month and year is presented in each appendix. Since pen and ink records taken before 1971 were made at 4-hour intervals, the maximum number of pen and ink record analyses in a 30-day month was 180; the maximum number of analyses in a 365-day year was 2,190. Recent

digital records have been analyzed at 6-hour intervals; therefore, the maximum number of digital analyses in a 30-day month is 120, and in a 365-day year is 1,460.

c. Monthly Maxima, Means, and Standard Deviations of Significant Height. Plots of monthly significant height statistics are included as figures in each appendix. Monthly means, identified by year and data type, are plotted for the recent and reliable data from each location. The range of monthly standard deviations obtained for each month of the year is also shown. Means and standard deviations are included only for months with 100 or more analyzed pen and ink records or 60 or more digital records.

The maximum significant height obtained for each month of the year is also shown in the plots. In several cases two maxima are plotted for each month, one maximum for digital analyses and one maximum for pen and ink record analyses.

Annual means and standard deviations of significant height are plotted at the right-hand edge of the figures for the more reliable and complete years of data. A complete plot of annual height statistics is given in Figure 17 of the text.

The data for Palm Beach and Port Hueneme were obtained by an old method of pen and ink record analysis and have been compensated to compare with data obtained by recent analysis methods (the compensation procedure is discussed later in this section).

d. Monthly Means and Standard Deviations of Significant Period. Each appendix contains figures of monthly significant period statistics. Monthly mean significant periods and the range of monthly standard deviations are plotted for the same months and in the same format as the significant height statistics. Annual significant period statistics are also included for the more reliable and complete years of data. A complete plot of annual period statistics is given in Figure 18 of the text.

e. Annual Significant Height Distribution Functions. Semilog plots of annual cumulative distribution functions of significant wave height are included as figures in the appendixes. At locations where more than 4 years of data are available, the distribution functions are plotted in clusters of from one to four curves, with the origin for each successive cluster spaced 5 scale meters above the previous origin. A distribution function corresponding to a relatively complete year of data is represented by a dashline common to all clusters. Distribution functions derived from both digital and pen and ink data are included in the plots.

In most years with less than 1,600 analyzed pen and ink records at 6 per day or less than 700 analyzed digital records at 4 per day, annual significant height distribution functions have been omitted. These cut-offs, discounting years of pen and ink results less than 73 percent

complete and years of digital results less than 48 percent complete, were chosen arbitrarily after examination of the data. A lenient cut-off for digital analyses seems justified since a digital estimate of significant height is more reliable than a pen and ink estimate, and gaps in the digital analyses are often unrelated to wave conditions.

The number of analyzed records in each year is listed within the boundaries of the plot. The plot for Pt. Conception, California, has been omitted because insufficient analyses were available to provide a meaningful annual distribution function of significant wave heights.

Some of the data for Atlantic City, Palm Beach, Naples, Port Hueneme, and Huntington Beach were obtained by an old method of pen and ink record analysis, and compensated to compare with data obtained by recent analysis methods (the compensation procedure is discussed later in this section).

f. Annual Significant Period Distribution Functions. Bar graphs of annual distribution functions of significant wave period obtained by the most reliable analysis method, preferably digital analysis, are presented in each appendix. Many of the graphs indicate the range of percentages in each interval obtained by an older, less reliable analysis method.

The median period for Atlantic coast gages is generally 8 to 9 seconds, although the number of wave periods occurring in the 8- to 9-second interval is exaggerated by the digital analysis (see Section V). For gulf coast gages, the median period ranges between 2 and 6 seconds; for Pacific coast gages, the median period is generally 14 to 15 seconds.

The figure for Pt. Conception has been omitted because of insufficient data.

g. Seasonal Significant Height Distribution Functions. Figures showing seasonal cumulative distribution functions of significant height for several individual months combined are included in each appendix. The distribution functions represent only data from months with 100 or more analyzed pen and ink records or 60 or more digital records, except in several months where insufficient data were available. The distribution functions also represent analyses from one homogeneous data source: Digital data, pen and ink data analyzed by the CERC method, or, for Palm Beach and Port Hueneme, pen and ink data analyzed by old BEB methods and suitably compensated by regression equations (the compensation procedure is discussed later in this section).

h. Joint Distribution Functions of Significant Height versus Period. Tables in most of the appendixes contain 13 tabular joint distribution functions of significant height and period. Results are summarized by months with 60 or more digital records or 100 or more pen and ink records. Each table summarizes monthly results from 1 to 4 years derived from a homogeneous data source: Digital data, pen and ink data analyzed by the CERC method, or, for Palm Beach and Port Hueneme, pen and ink data

analyzed by old BEB methods, with heights suitably compensated by regression equations (discussed later). The monthly tables of joint distribution functions are followed by a single table summarizing all monthly data.

For locations with sizable quantities of both digital and pen and ink data, results are summarized from the more abundant source as discussed above. Results from the less abundant source are summarized in an additional table for use in evaluating extreme conditions.

Each table indicates the months and years and the total number of observations represented. The main body of the table gives the number of observations for which the significant height and period were within the specified intervals. All numbers in the interior of the table have been normalized to give the number of observations per 1,000 observations. These numbers can be converted to percent by dividing by 10.

Marginal totals are also included. The row labeled "Total" gives the total number of observations out of 1,000 which fell within each specified significant height interval. The column total gives the number of observations out of 1,000 which fell within each specified period interval. Observations in the lowest period interval usually represent calm conditions, but were not considered in normalizing the column totals. The cumulative totals in the tables are totals of the entries in the "Total" row and column.

Each entry in the "Row Average" column gives the average significant height for all observations within a specified period interval. Entries under "Column Average" are the average significant period for all observations within a specified height interval. The row and column averages are useful for investigating the relationship between significant height and period. For most ocean coastal locations the largest significant heights are usually associated with intermediate periods. However, the tables show no consistent simple relationship between significant height and period. A tendency for significant period to increase with increasing significant height is apparent for gulf coast and Chesapeake Bay locations.

At the bottom of each table is a list of the average, variance, and standard deviation of both significant heights and significant periods. The type of data and gage used to obtain the data summarized in the table along with other remarks are footnoted.

i. Compensation for Different Pen and Ink Analysis Methods. Results obtained by the older, less reliable methods of pen and ink record analysis discussed in Section IV are included for several locations. These results are grouped into relatively homogeneous blocks according to the method of analysis and the person performing the analysis.

For Atlantic City, Palm Beach, and Huntington Beach, a 1- to 2-month sample of pen and ink records from each block was reanalyzed with the

CERC method. For each sample, a linear regression equation was computed for significant height estimates obtained by the two methods and for significant period estimates. Where necessary, the appropriate regression equation was applied to significant wave height statistics obtained by the old methods of analysis. Regression equations from the above locations were applied to data from Virginia Beach, Naples, and Port Hueneme to compensate old significant wave height statistics.

Significant wave period statistics obtained by the old methods of pen and ink record analysis are included for Palm Beach and Port Hueneme, but have not been compensated.

Details of the compensation for each location are included in a table.

j. Time History of Significant Height and Period. Figures for an east coast location (Atlantic City) and a west coast location (Huntington Beach), are included in the appendixes to give perspective on the time history of significant height and period during 4 months of high wave activity.

k. Monthly Significant Height Distribution Functions. Each curve in the plots of seasonal significant height distribution functions represents an average of from 1 to 4 months. A number of plotted monthly significant height distribution functions are included in the appendixes for Atlantic City and Huntington Beach. The monthly distribution functions are plotted in the standard format and show trends toward high or low wave conditions in some months, but also show considerable variability for different years. The plots do not include the number of analyzed records for each month; however, the number can be determined from the tables listing the number of analyzed records for each month and year.

APPENDIX A-1

SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. ATLANTIC COAST



Figure A-1. Location of BEB-CERC wave gages along the U.S. Atlantic coast.

Table A-1. CERC wave gage history for Coast Guard Light Tower, Buzzards Bay, Massachusetts.

CERC Form 174-74 18 Mar 74		LOCATION: Coast Guard Light Tower, Buzzards Bay, Massachusetts					
COORDINATES: 41°24' N., 71°02' W.							
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Pier Length (feet)
Step-resistance (SR), staff-relay type	19 Nov. 1962	27 Nov. 1962	Gage secured for winter; inoperable due to icing and other problems.	45		63	Tower is about 6 nmi from shore.
Pressure	17 June 1963	23 Nov. 1963	Gage returned to CERC for general repair.		-6.5 to +38.5 (mounted 6.5 ft below MSL)	63	Tower is about 6 nmi from shore.
SR staff-relay type	23 Jan. 1964	18 Apr. 1965	Gage removed.		-17 to +28	63	Tower is about 6 nmi from shore.
Pressure	12 May 1965	13 Aug. 1965	Gage removed.	45		63	Tower is about 6 nmi from shore.
	12 Oct. 1965	3 Feb. 1966	Gage destroyed by storm; not replaced.		-8 to +37 (mounted 8 ft below MSL)	63	Tower is about 6 nmi from shore.

Table A-2. Number of analyzed pen and ink records from Buzzards Bay, Massachusetts.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1963						84	101	85	124	161	118		673
1964	50	167	123	162	176	122	158	150	145	166	66	181	1666
1965	183	144	182	104	39	78	86	30		84	147	179	1256

¹From 7-minute records taken six times daily; analyzed by the second BEB method for 1963 and by the CERC method for 1964-65.

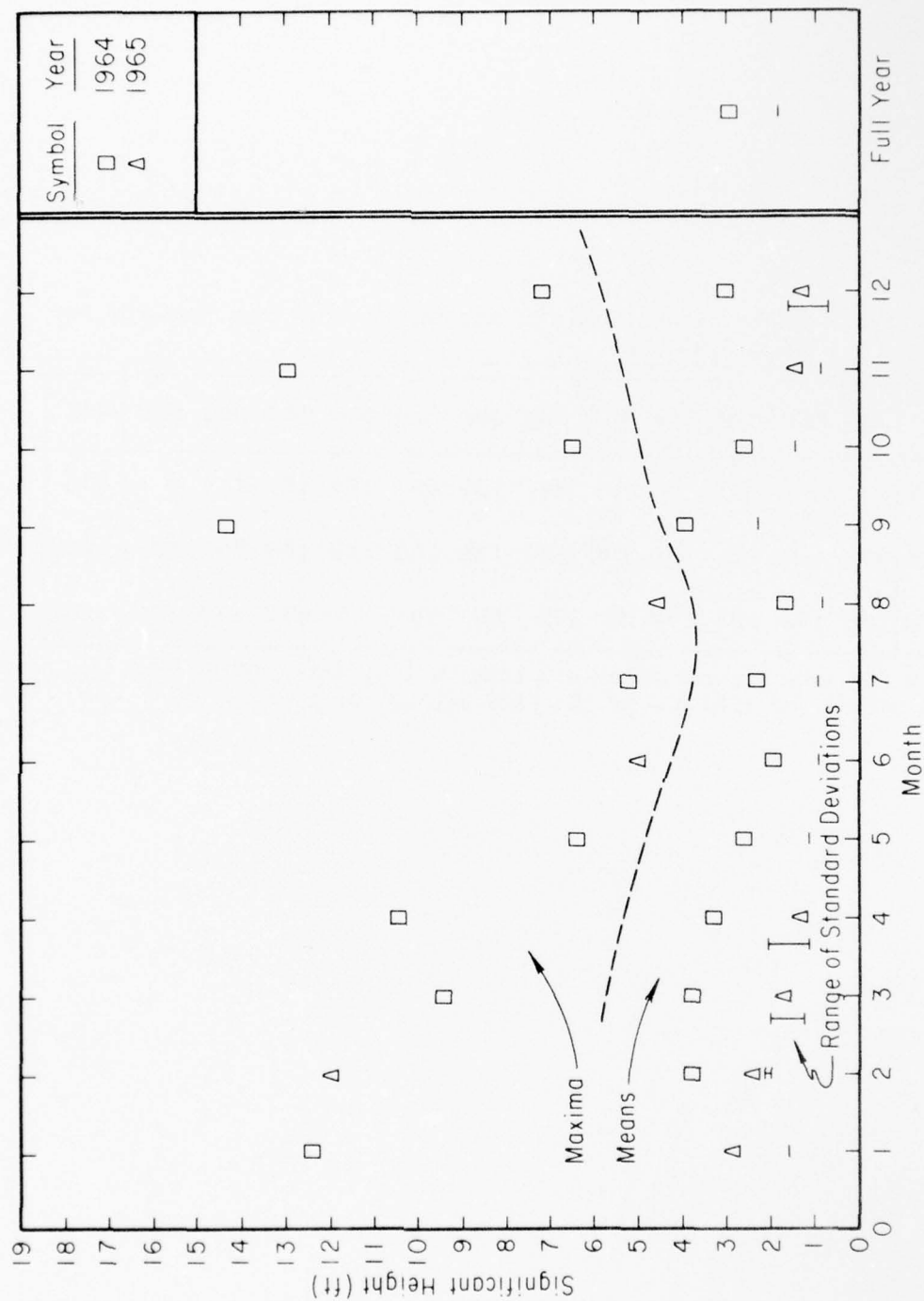


Figure A-2. Maxima, means, and standard deviations of significant height from Buzzards Bay, Massachusetts; determined from 7-minute pen and ink records taken six times daily.

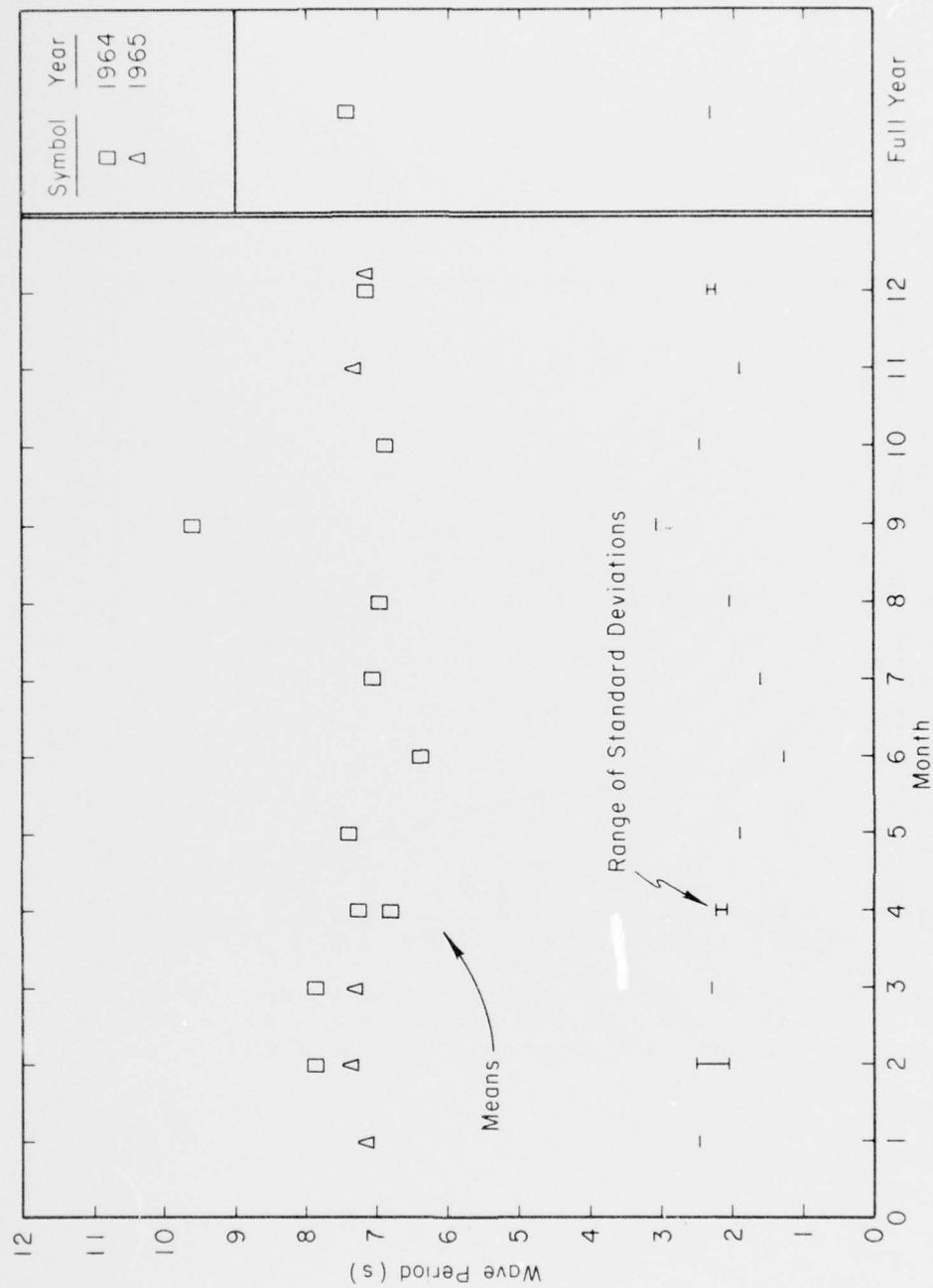


Figure A-3. Means and standard deviations of wave period from Buzzards Bay, Massachusetts; determined from 7-minute pen and ink records taken six times daily.

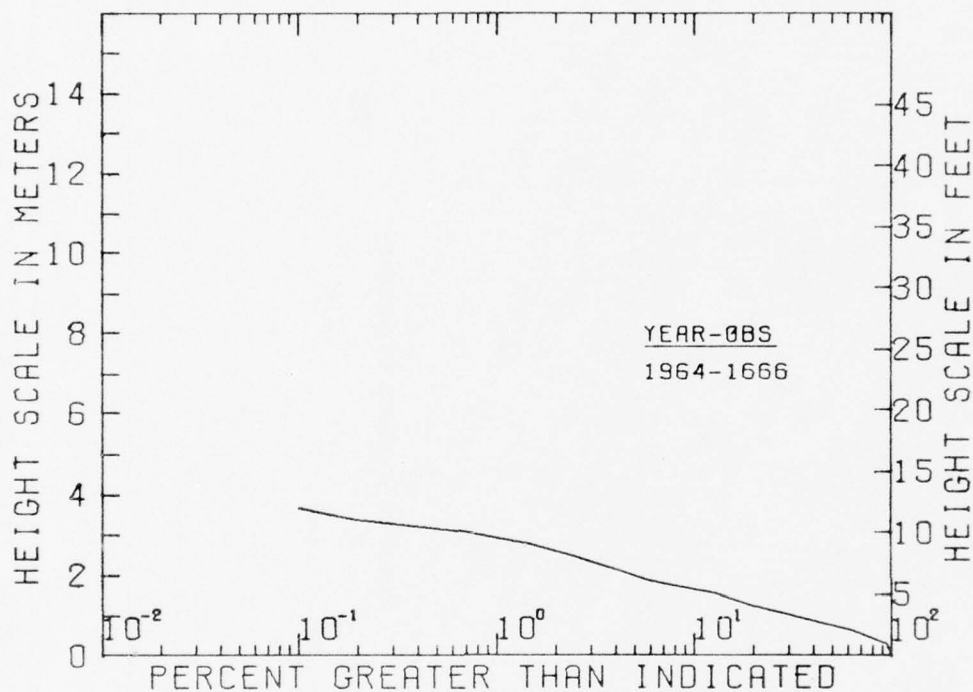


Figure A-4. Annual cumulative significant height distribution from Buzzards Bay, Massachusetts; determined from 7-minute pen and ink records taken six times daily.

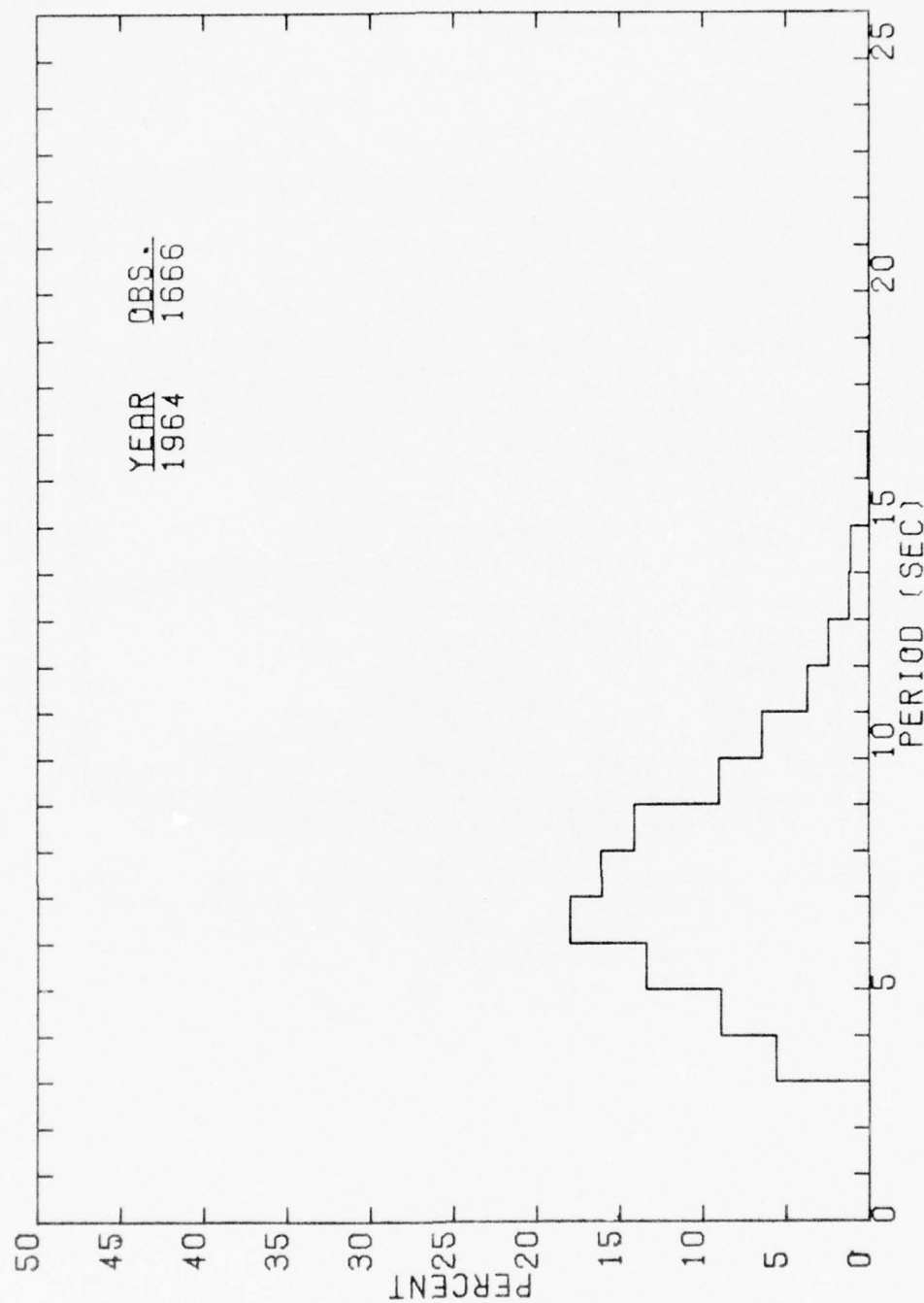


Figure A-5. Annual significant period distributions from Buzzards Bay, Massachusetts; determined from 7-minute pen and ink records taken six times daily.

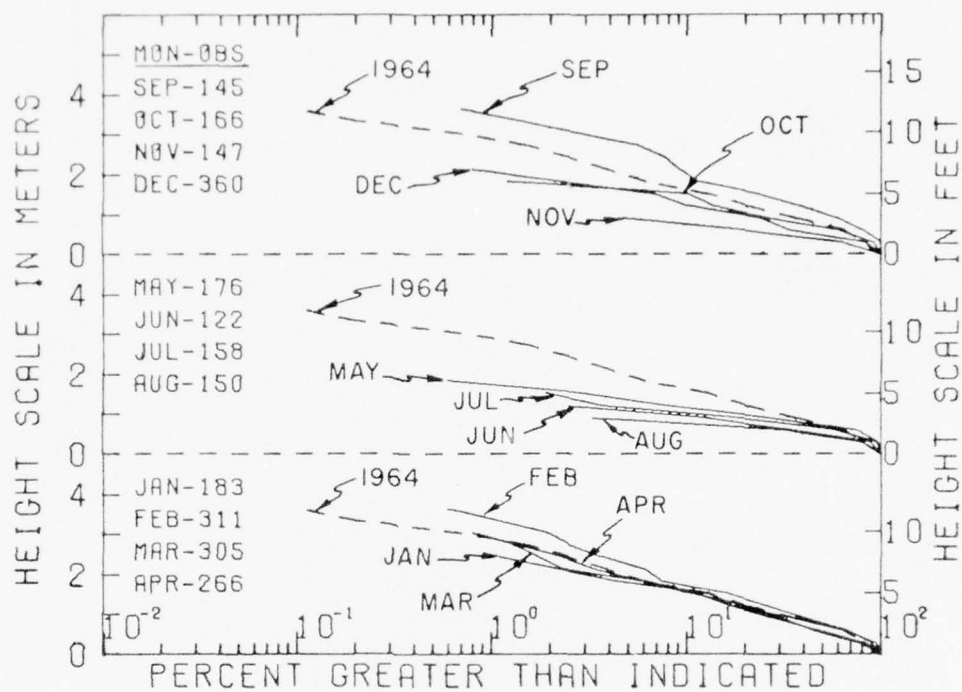


Figure A-6. Seasonal summaries of cumulative significant height distributions from Buzzards Bay, Massachusetts; determined from 7-minute pen and ink records taken six times daily.

BEST AVAILABLE COPY

Table A-3. Wave climate for Buzzards Bay, Massachusetts.
Distribution of significant height versus period
(in observations per 1,000 observations).

183 OBSERVATIONS										SUMMARY FOR JAN 65		
PERIOD (SECS)										HEIGHT (FT)		
0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	HON. AVG.*	
0.0 = 1.9	27									1000	.00	
2.0 = 2.4										1000	.00	
2.5 = 2.9										1000	.00	
3.0 = 3.4		11								11	1.50	
3.5 = 3.9		27	22	5						56	2.10	
4.0 = 4.9		71	11	11	11	22	5			140	3.10	
5.0 = 5.9	5	22	93	60	5	5		5		197	2.84	
6.0 = 6.9		11	38	44	16					112	3.25	
7.0 = 7.9	5	11	22	16	5	22	22			107	4.03	
8.0 = 8.9		22	27	27	16	11		5		112	3.45	
9.0 = 9.9	11	49	22	11	5	11				112	2.35	
10.0 = 10.9		49	38	5						96	2.03	
11.0 = 11.9		5	22	5						34	2.50	
12.0 = 12.9	5			5						11	2.00	
13.0 = 13.9											.00	
14.0 = 14.9	11									11	.50	
TOTAL	66	279	295	191	38	87	53	11			2.82	
CUM. TOTAL	1000	934	656	361	169	131	44	11	11			
COL. AVG.	10.50*	7.04	7.28	6.96	7.36	6.81	6.67	.00	6.50	7.21		
AVERAGE SIG. HEIGHT = 2.82 FT										AVERAGE WAVE PERIOD = 7.21 SEC*		
VARIANCE OF SIG. HEIGHT = 2.49 FT SQ										VARIANCE OF WAVE PERIOD = 5.86 SEC SQ*		
STANDARD DEVIATION OF HEIGHT = 1.58 FT										STANDARD DEVIATION OF PERIOD = 2.42 SEC*		

AVERAGE SIG. HEIGHT = 2.82 FT
VARIANCE OF SIG. HEIGHT = 2.49 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.58 FT
AVERAGE WAVE PERIOD = 7.21 SEC*
VARIANCE OF WAVE PERIOD = 5.86 SEC SQ*
STANDARD DEVIATION OF PERIOD = 2.42 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
WAVE GAGE LOCATED AT COAST GUARD LIGHT
* CALMS ARE OMITTED.

311 OBSERVATIONS														SUMMARY FOR FEB 65		
PERIOD (SECS)														HEIGHT (FT)		
0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	12=13	TOT.*	CUM. HON.	TOT.*	AVG.*
0.0 = 1.9	19													1000	1000	.00
2.0 = 2.4														1000	1000	.00
2.5 = 2.9														1000	1000	.00
3.0 = 3.4	3													3	1000	.50
3.5 = 3.9		6	10											20	997	2.50
4.0 = 4.9	4	29	23	19	6	16	3							105	977	3.00
5.0 = 5.9	3	35	64	19	10	10								144	872	2.68
6.0 = 6.9		45	45	32	19	10								147	728	3.28
7.0 = 7.9	6	26	42	29	13	19	3							141	591	3.15
8.0 = 8.9	39	29	23	13	6	14								121	420	2.07
9.0 = 9.9	23	23	26	13	13	6	3							111	298	2.71
10.0 = 10.9	3	23	13	3	13	10	3							88	187	4.46
11.0 = 11.9		6	10	16	13	3	3							59	96	4.17
12.0 = 12.9			3	3	3	3	3							30	39	7.30
13.0 = 13.9	3	3												10	10	2.17
TOTAL	106	225	257	148	103	87	13	23	13	6	13		6			3.13
CUM. TOTAL	1000	894	669	412	268	161	74	61	39	26	19		6			
COL. AVG.	8.34*	7.32	7.07	7.50	8.35	7.54	9.00	9.36	9.75	9.00	11.00	.80	12.58	7.64		

AVERAGE SIG. HEIGHT = 3.13 FT
VARIANCE OF SIG. HEIGHT = 4.61 FT SQ
STANDARD DEVIATION OF HEIGHT = 2.15 FT
AVERAGE WAVE PERIOD = 7.64 SEC*
VARIANCE OF WAVE PERIOD = 5.34 SEC SQ*
STANDARD DEVIATION OF PERIOD = 2.32 SEC*

BEST AVAILABLE COPY

305 OBSERVATIONS

SUMMARY FOR MAR 64 MAR 65

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW
1.0 = 1.9	72											1000	.00
2.0 = 2.4												1000	.00
2.5 = 2.9												1000	.00
3.0 = 3.4												1000	.00
3.5 = 3.9	10	13		3								18	1000 1.90
4.0 = 4.9	7	20	10	3								46	982 1.65
4.5 = 4.9	3	66		10			3					92	936 1.85
5.0 = 5.9	3	49	46	10	3	7	3					131	845 2.45
6.0 = 6.9	7	39	23	20	13	7	3					120	714 2.74
7.0 = 7.9	20	26	30	23	13	13	10					145	594 2.96
8.0 = 8.9	33	43	49	7	7	3	10	3				170	449 2.50
9.0 = 9.9	16	26	16	23		13	7			3		113	279 3.00
10.0 = 10.9	10	36	16	10	13		3	7				3	106 3.00
11.0 = 11.9	3	13	3	3	7	7				3		42	60 3.50
12.0 = 12.9		7		3	3							14	18 2.75
13.0 = 13.9												4	4 .00
14.0 = 14.9		3										4	4 1.50
TOTAL	180	341	193	115	59	49	39	10		13			2.48
CUM. TOTAL	1000	820	479	283	170	111	62	23	13	13			
COL. AVG.	7.86*	7.05	7.46	7.84	8.07	8.23	7.83	9.83	.00	10.00	7.57		

AVERAGE SIG. HEIGHT = 2.48 FT
 VARIANCE OF SIG. HEIGHT = 3.37 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.84 FT
 AVERAGE WAVE PERIOD = 7.57 SEC*
 VARIANCE OF WAVE PERIOD = 5.21 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.28 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT COAST GUARD LIGHT
 * CALMS ARE OMITTED.

266 OBSERVATIONS

SUMMARY FOR APR 64 APR 65

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	TOT.*	CUM. TOT.*	ROW AVG.*
1.0 = 1.9	109												1000	.00
2.0 = 2.4													1000	.00
2.5 = 2.9													1000	.00
3.0 = 3.4	4	4	4	4								17	1000	2.00
3.5 = 3.9	8	23	8	8	11							63	983	2.37
4.0 = 4.9	30	38	8	19	8	8	4	4				131	920	2.44
4.5 = 5.9	19	38	26	15	4	4						118	789	2.11
5.0 = 6.9	15	41	19	15	4	8	4					118	671	2.39
7.0 = 7.9	19	56	41	15	15	8	4	4	4			186	553	2.68
8.0 = 8.9	19	41	23	15	15	8	4					139	367	2.53
9.0 = 9.9	19	49	4	11	11	8	4	4	8		8	139	228	3.38
10.0 = 10.9	4	8	8	11	23	4	8		4			76	89	4.06
11.0 = 11.9		8			4							13	13	2.50
TOTAL	244	305	139	113	94	45	26	11	15		8			2.45
CUM. TOTAL	1000	756	451	312	199	105	60	34	23	8	8			
COL. AVG.	6.62*	7.05	6.89	6.84	7.97	7.42	8.21	7.17	9.25	.00	9.50	7.14		

AVERAGE SIG. HEIGHT = 2.45 FT
 VARIANCE OF SIG. HEIGHT = 3.90 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.97 FT
 AVERAGE WAVE PERIOD = 7.14 SEC*
 VARIANCE OF WAVE PERIOD = 4.42 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.10 SEC*

BEST AVAILABLE COPY

176 OBSERVATIONS

SUMMARY FOR MAY 64

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 = 1.9									1000	.00
2.0 = 2.4									1000	.00
2.5 = 2.9									1000	.00
3.0 = 3.4									1000	.00
3.5 = 3.9			6					6	1000	1.50
4.0 = 4.9		11		40				51	994	3.06
5.0 = 5.9		34	62	40	11			148	943	2.69
6.0 = 6.9		40	102	40	23	17		222	795	2.94
7.0 = 7.9	28	68	114	23	17	6	6	261	574	2.39
8.0 = 8.9	11	34	102	6				153	312	2.17
9.0 = 9.9	6	6	62	6				80	159	2.36
10.0 = 10.9		6	6	11				23	80	2.75
11.0 = 11.9			17	6				23	57	2.75
12.0 = 12.9			6	6				17	34	2.50
13.0 = 13.9			6	11				17	17	2.83
TOTAL	45	216	472	187	51	23	6			2.57
CUM. TOTAL	1000	955	739	267	80	26	6			
COL. AVG.	8.00*	7.32	7.74	7.14	6.61	6.75	7.50	7.47		

AVERAGE SIG. HEIGHT = 2.57 FT
VARIANCE OF SIG. HEIGHT = 1.08 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.04 FT

AVERAGE WAVE PERIOD = 7.47 SEC*
VARIANCE OF WAVE PERIOD = 3.43 SEC SQ*
STANDARD DEVIATION OF PERIOD = 1.85 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
WAVE GAGE LOCATED AT COAST GUARD LIGHT
* CALMS ARE OMITTED.

122 OBSERVATIONS

SUMMARY FOR JUN 64

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 = 1.9							1000	.00
2.0 = 2.4							1000	.00
2.5 = 2.9							1000	.00
3.0 = 3.4							1000	.50
3.5 = 3.9		16	16			33	992	1.00
4.0 = 4.9			25	33	8	74	959	2.50
5.0 = 5.9		8	115	41	25	197	885	2.04
6.0 = 6.9	25	213	123	49	8	418	689	2.03
7.0 = 7.9	41	123	25	8		197	270	1.50
8.0 = 8.9	16	33		8		57	74	1.50
9.0 = 9.9							16	.00
10.0 = 10.9		16				16	16	1.50
TOTAL	115	541	221	98	25			1.88
CUM. TOTAL	1000	885	344	123	25			
COL. AVG.	6.45*	6.98	6.13	6.33	5.50	6.42		

AVERAGE SIG. HEIGHT = 1.88 FT
VARIANCE OF SIG. HEIGHT = .81 FT SQ
STANDARD DEVIATION OF HEIGHT = .90 FT

AVERAGE WAVE PERIOD = 6.42 SEC*
VARIANCE OF WAVE PERIOD = 1.51 SEC SQ*
STANDARD DEVIATION OF PERIOD = 1.23 SEC*

158 OBSERVATIONS

SUMMARY FOR JUL 64

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM, * TOT, *	ROW AVG, *
1.0 = 1.9								1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9			13				13	1000	1.50
4.0 = 4.9		127	6				133	987	1.55
5.0 = 5.9	6	51	13				70	854	1.59
6.0 = 6.9	13	44	127	70			253	785	2.50
7.0 = 7.9	25	51	127	19	6		228	532	2.19
8.0 = 8.9		44	45	38	6	13	196	304	2.73
9.0 = 9.9	13	13	19	13	6	6	70	108	2.59
10.0 = 10.9		19	19				38	38	2.00
TOTAL	57	361	405	139	19	19			2.26
CUM. TOTAL	1000	943	582	177	38	19			
COL. AVG.	7.50*	6.26	7.55	7.45	8.50	8.83	7.11		

AVERAGE SIG. HEIGHT = 2.26 FT

AVERAGE WAVE PERIOD = 7.11 SEC*

VARIANCE OF SIG. HEIGHT = .92 FT SQ

VARIANCE OF WAVE PERIOD = 2.57 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .96 FT

STANDARD DEVIATION OF PERIOD = 1.60 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
WAVE GAGE LOCATED AT COAST GUARD LIGHT

* CALMS ARE OMITTED.

150 OBSERVATIONS

SUMMARY FOR AUG 64

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	TOT, *	CUM, * TOT, *	ROW AVG, *
1.0 = 1.9	47					1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4						1000	.00
3.5 = 3.9	20	27	13		63	1000	1.39
4.0 = 4.9		47	40	7	98	937	2.07
5.0 = 5.9	20	120	33		182	839	1.58
6.0 = 6.9	33	113	47		203	657	1.57
7.0 = 7.9	20	60	87	7	182	455	1.96
8.0 = 8.9	20	27	60	13	126	273	2.06
9.0 = 9.9	20	7	7	7	42	147	1.50
10.0 = 10.9	13	47			63	105	1.28
11.0 = 11.9	20	7			28	42	.75
12.0 = 12.9	7	7			14	14	1.00
TOTAL	220	460	287	33			1.63
CUM. TOTAL	1000	780	320	33			
COL. AVG.	7.87*	6.73	6.77	7.70	6.98		

AVERAGE SIG. HEIGHT = 1.63 FT

AVERAGE WAVE PERIOD = 6.98 SEC*

VARIANCE OF SIG. HEIGHT = .62 FT SQ

VARIANCE OF WAVE PERIOD = 4.09 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .79 FT

STANDARD DEVIATION OF PERIOD = 2.02 SEC*

BEST AVAILABLE COPY

145 OBSERVATIONS SUMMARY FOR SEP 54

PERIOD (SECS)	HEIGHT (FT)													TOT.*	CUM. TOT.*	RO- AVG.*
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13 +		
1.0 = 1.0															1000	.00
2.0 = 2.0															1000	.00
2.5 = 2.5															1000	.00
3.0 = 3.0															1000	.00
3.5 = 3.5		28	7	7											41	1000 2.00
4.0 = 4.0			7		7										14	959 3.50
5.0 = 5.0		28	7	21	7	21									83	945 3.33
6.0 = 6.0		28	21	62	7	7									117	862 2.97
7.0 = 7.0		21	21	14	7	7									62	745 2.61
8.0 = 8.0		28	34	14	7	7									90	683 2.73
9.0 = 9.0	7	41	14	7	14	21									103	593 2.91
10.0 = 10.0		14	7	34	28	7	7								97	490 3.79
11.0 = 11.0		7	34	14	34	41			7						138	393 4.25
12.0 = 12.0			28	34	14	14				14				7	110	255 5.00
13.0 = 13.0			21	7	21										62	145 4.83
14.0 = 14.0					14	7	14	7							53	83 7.67
TOTAL	7	193	220	214	152	124	21	14	14	14	14			7		3.90
CUM. TOTAL	1000	993	870	650	398	274	111	90	76	55	28	14		7		
COL. AVG.	9.50*	7.26	9.51	8.77	10.26	8.74	11.17	14.00	13.50	13.50	14.50	13.50		12.50	9.26	

AVERAGE SIG. HEIGHT = 3.91 FT AVERAGE WAVE PERIOD = 9.66 SEC
 VARIANCE OF SIG. HEIGHT = 5.39 FT SQ VARIANCE OF WAVE PERIOD = 9.11 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 2.32 FT STANDARD DEVIATION OF PERIOD = 3.02 SEC

RESULTS OBTAINED FROM TWIN TIDE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAUGE LOCATED AT COAST GUARD LIGHT
 * CALCS FOR OBTAINED.

166 OBSERVATIONS SUMMARY FOR OCT 64

PERIOD (SECS)	HEIGHT (FT)								TOT.*	CUM. TOT.*	RO- AVG.*
	0-1	1-2	2-3	3-4	4-5	5-6	6-7				
1.0 = 1.0	12								12	1000	.00
2.0 = 2.0										1000	.00
2.5 = 2.5										1000	.00
3.0 = 3.0										1000	.00
3.5 = 3.5		24	12						37	1000 1.83	
4.0 = 4.0	6	72	30	12			6		128	963 2.07	
5.0 = 5.0		48	24	36					110	835 2.59	
6.0 = 6.0	18	42	42	18		12	6		140	726 2.50	
7.0 = 7.0		42	54	6		18			122	585 2.65	
8.0 = 8.0	6	24	18	12		6			67	463 2.41	
9.0 = 9.0	30	42	84	12	18	12			201	396 2.41	
10.0 = 10.0	6	6	66	6	12				98	195 2.62	
11.0 = 11.0			6	24	6	30			67	98 4.41	
12.0 = 12.0							6		6	30 6.50	
13.0 = 13.0									6	24 5.50	
14.0 = 14.0									6	18 2.50	
TOTAL	78	307	340	127	36	90	12		12	12 2.00	
CUM. TOTAL	1000	422	614	265	139	102	12			2.55	
COL. AVG.	7.25*	5.72	7.32	6.71	9.17	8.25	8.50		6.91		

AVERAGE SIG. HEIGHT = 2.55 FT AVERAGE WAVE PERIOD = 6.91 SEC
 VARIANCE OF SIG. HEIGHT = 1.89 FT SQ VARIANCE OF WAVE PERIOD = 6.04 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.38 FT STANDARD DEVIATION OF PERIOD = 2.46 SEC

147 OBSERVATIONS

SUMMARY FOR NOV 65

PERIOD (SECS)	HEIGHT (FT)				CUM. ROW		
	0=1	1=2	2=3	3=4	TOT. #	TOT. #	AVG. #
1.0 = 1.9	54					1000	.00
2.0 = 2.9						1000	.00
3.0 = 3.9						1000	.00
4.0 = 4.9	27				29	1000	.50
5.0 = 5.9	34	27			65	971	1.44
6.0 = 6.9	27	109	14		158	906	1.41
7.0 = 7.9	54	116	48	7	237	748	1.53
8.0 = 8.9	34	48	48	27	165	511	1.93
9.0 = 9.9	48	41	34	14	144	345	1.60
10.0 = 10.9	48	61			115	201	1.06
11.0 = 11.9	14	20	7		43	86	1.33
12.0 = 12.9	20	14			36	43	.90
TOTAL	7				7	7	.50
CUM. TOTAL	367	435	150	48			1.38
COL. AVG.	1000	833	197	48			
	7.46	7.19	7.36	7.64	7.33		

AVERAGE SIG. HEIGHT = 1.38 FT
 VARIANCE OF SIG. HEIGHT = .69 FT SQ
 STANDARD DEVIATION OF HEIGHT = .83 FT

AVERAGE WAVE PERIOD = 7.33 SEC
 VARIANCE OF WAVE PERIOD = 3.58 SEC SQ
 STANDARD DEVIATION OF PERIOD = 1.89 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT COAST GUARD LIGHT
 * CALMS ARE OMITTED.

360 OBSERVATIONS

SUMMARY FOR DEC 64 DEC 65

PERIOD (SECS)	HEIGHT (FT)								CUM. ROW		
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT. #	TOT. #	AVG. #
1.0 = 1.9	17									1000	.00
2.0 = 2.9										1000	.00
3.0 = 3.9										1000	.00
4.0 = 4.9	3								3	1000	.50
5.0 = 5.9	19	28	3						51	997	1.17
6.0 = 6.9	22	50	8	17	3	8			110	946	2.06
7.0 = 7.9	17	103	19	22	3	8	8	6	184	836	2.38
8.0 = 8.9	17	86	31	36	6	6		3	186	647	2.27
9.0 = 9.9	8	33	14	28	6	17			107	460	2.67
10.0 = 10.9	17	69	25	28	8	6	3		158	353	2.30
11.0 = 11.9	25	50		8	8	3			96	195	1.79
12.0 = 12.9	11	22			3		3		40	99	1.79
13.0 = 13.9	6	11							17	59	1.17
14.0 = 14.9	6	14							20	42	1.21
15.0 = 15.9	6	3							8	23	.83
16.0 = 16.9		11							11	14	1.50
TOTAL	3								3	3	.00
CUM. TOTAL	172	483	100	139	36	47	14	8			2.12
COL. AVG.	1000	828	344	244	106	69	22	8			
	7.56	7.34	6.70	6.88	7.88	6.74	7.10	5.83	7.19		

AVERAGE SIG. HEIGHT = 2.12 FT
 VARIANCE OF SIG. HEIGHT = 2.17 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.47 FT

AVERAGE WAVE PERIOD = 7.19 SEC
 VARIANCE OF WAVE PERIOD = 5.36 SEC SQ
 STANDARD DEVIATION OF PERIOD = 2.31 SEC

BEST AVAILABLE COPY

24-Hr Observations

SUMMARY FOR 16 MONTHS FEB 64 THROUGH DEC 65

PERIOD (SECS)	HEIGHT (FT)													TOT.	CUM. HO.	HO.	AVG.
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13			
1.0 - 1.9	34														1000	1.00	
2.0 - 2.9															1000	1.00	
3.0 - 3.9															1000	1.00	
4.0 - 4.9															1000	1.00	
5.0 - 5.9															1000	1.00	
6.0 - 6.9															1000	1.00	
7.0 - 7.9															1000	1.00	
8.0 - 8.9															1000	1.00	
9.0 - 9.9															1000	1.00	
10.0 - 10.9															1000	1.00	
11.0 - 11.9															1000	1.00	
12.0 - 12.9															1000	1.00	
13.0 - 13.9															1000	1.00	
14.0 - 14.9															1000	1.00	
TOTAL	144	343	238	131	55	51	10	7	5	4	3	2	1	1	1000	1.00	
CUM. TOTAL	1000	856	513	275	144	88	37	21	14	9	5	2	1		1000	1.00	
CUM. AVG.	7.55	6.97	7.33	7.30	7.40	7.84	8.17	8.00	8.96	11.20	11.50	13.50	12.50	7.40			
AVERAGE SIG. HEIGHT * 2.46 FT																	
VARIANCE OF SIG. HEIGHT * 2.87 FT SQ																	
STANDARD DEVIATION OF HEIGHT * 1.70 FT																	
AVERAGE WAVE PERIOD * 7.30 SECS																	
VARIANCE OF WAVE PERIOD * 5.27 SEC SQ																	
STANDARD DEVIATION OF PERIOD * 2.30 SECS																	
RESULTS OBTAINED FROM 1-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE																	
WAVE GAUGE LOCATED AT COAST GUARD LIGHT																	
* CAL'S ARE OMITTED.																	

Table A-4. CERC wave gage history for Steel Pier, Atlantic City, New Jersey.

CERC Form 174-74 18 Mar 74									
COORDINATES: 39°21'N., 74°25'W.					LOCATION: Steel Pier, Atlantic City, New Jersey				
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)	
Step-resistance (SR), staff-spark plug type	21 Apr. 1948	11 Aug. 1948	Gage removed.	25		17	0	1,500	
SR staff-parallel type	28 Sept. 1957	6 Mar. 1962	Gage destroyed by storm.	25	-7.7 to 17.3	17	0	1,500	
SR staff-relay type	31 Aug. 1962	6 May 1964	Lower half of gage destroyed.	25	-7.7 to 17.3	17	0	1,500	
SR staff-relay type	20 May 1964	27 Dec. 1969	Gage and part of pier destroyed by fire.	25	-7.7 to 17.3	17	0	1,500	
Continuous-wire staff	8 Aug. 1970	1 Jan. 1971	Gage destroyed by storm; not replaced.	25	-7.7 to 17.3	17	0	1,500	

Table A-5. Number of analyzed records from Atlantic City, New Jersey.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1957									14	150	141	169	474
1958	151	154	70	180	186	180	186	186	179	175	179	131	1957
1959	114	112	186	164	152	161	163	120	177	173	157	136	1815
1960	172	93	153	138	168	148	148	143	123	162	153	136	1737
1961	35	101	119	79	136	111	169	132	122	182	153	171	1510
1962	186	167	15					2	129	168	176	173	1016
1963	178	160	162	175	165	172	186	178	111	180	179	180	2026
1964	186	159	185	159	83	178	186	185	168	188	179	186	2042
1965	185	162	186	178	150	66	129	141	105	166	164	181	1813
1966	168	141	185	169	161	178	142			154	178	183	1659
1967	186	147	183	177	162	172	182	175	163	181	176	179	2083
1968												119	119
1969	109	105	109	115	91	71	121	121	110	92			1044

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the second BEB for 1957 to March 1964 and by the CERC method for April 1964 to 1967. Results after November 1968 obtained from 1,024-second digital records taken four times daily.

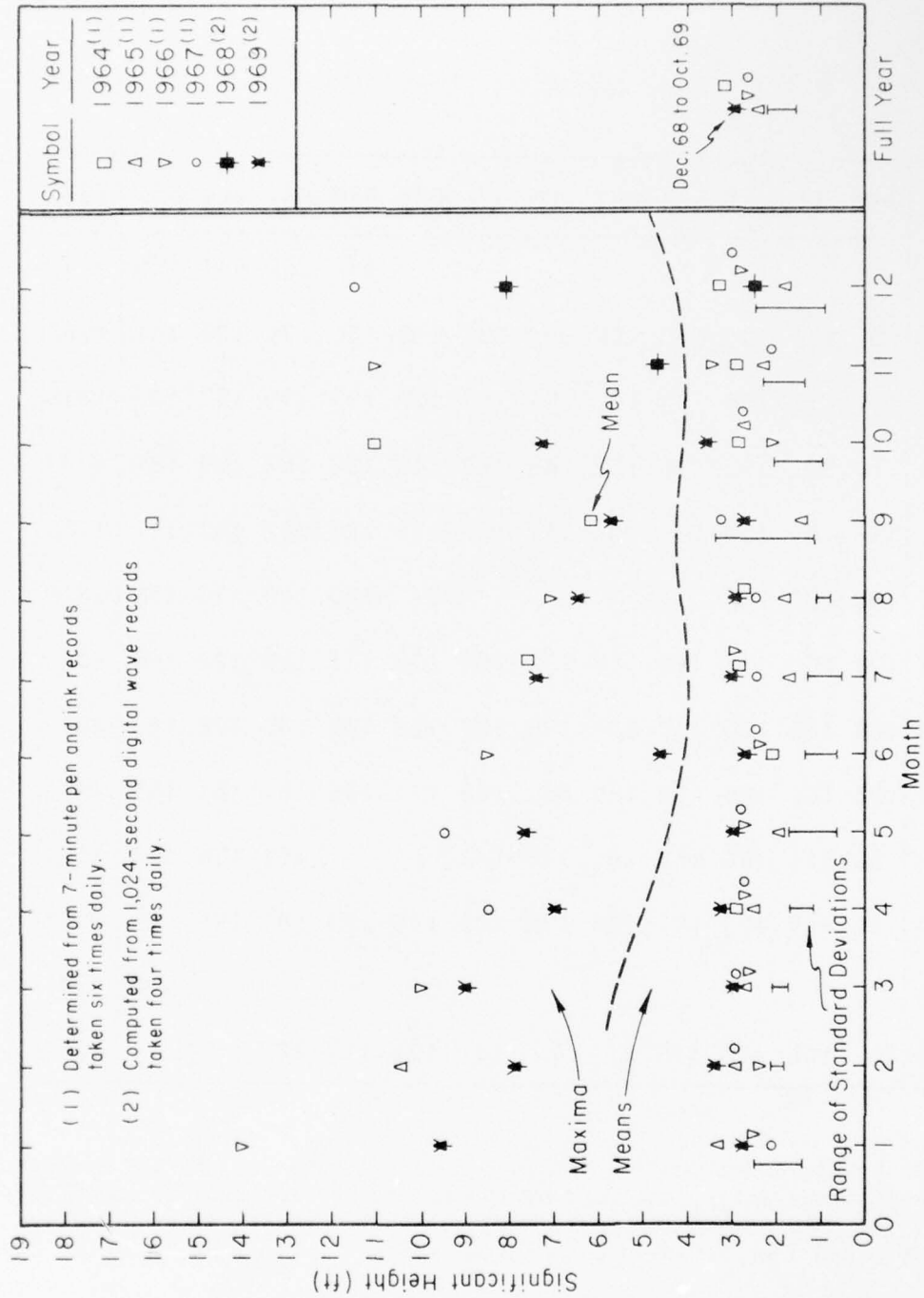


Figure A-7. Maxima, means, and standard deviations of significant height from Atlantic City, New Jersey.

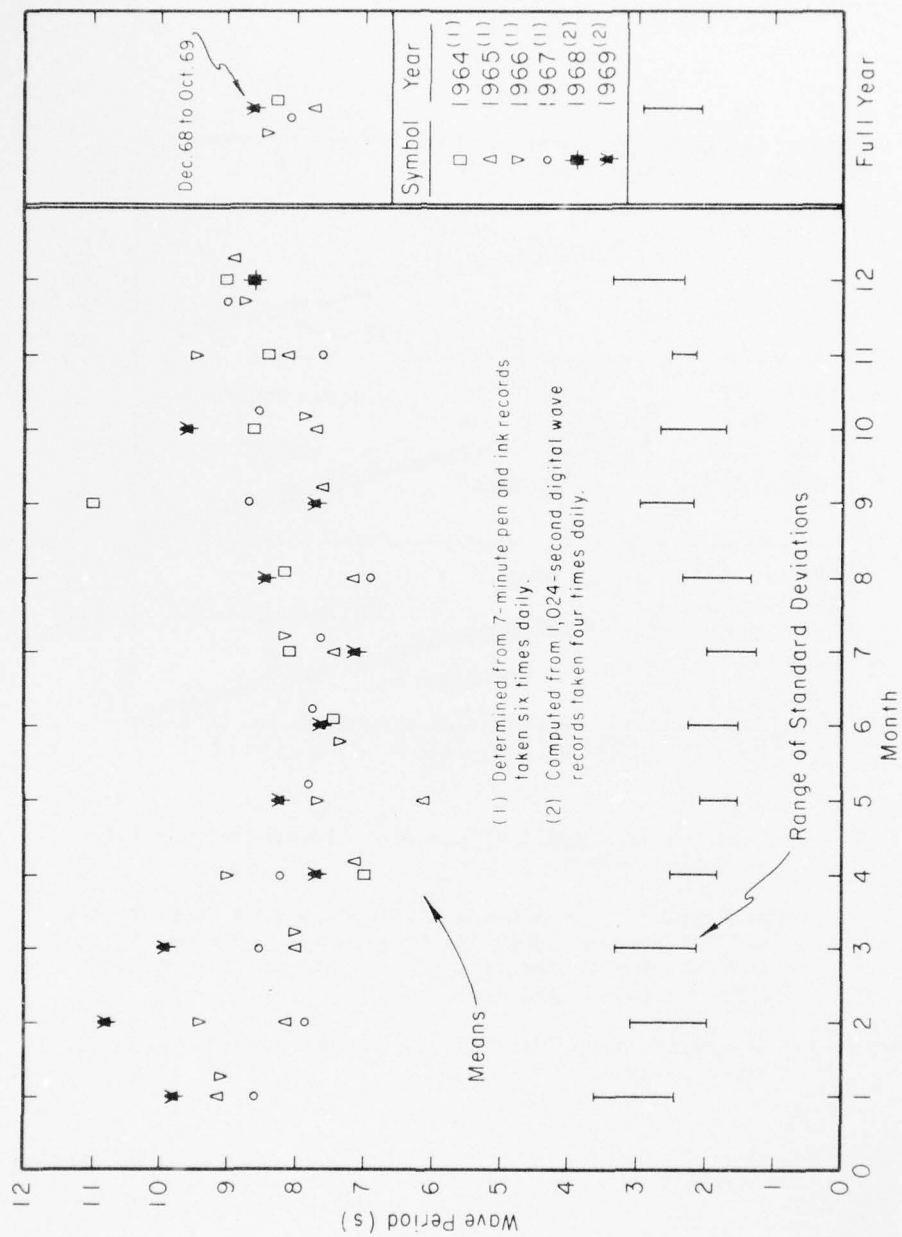
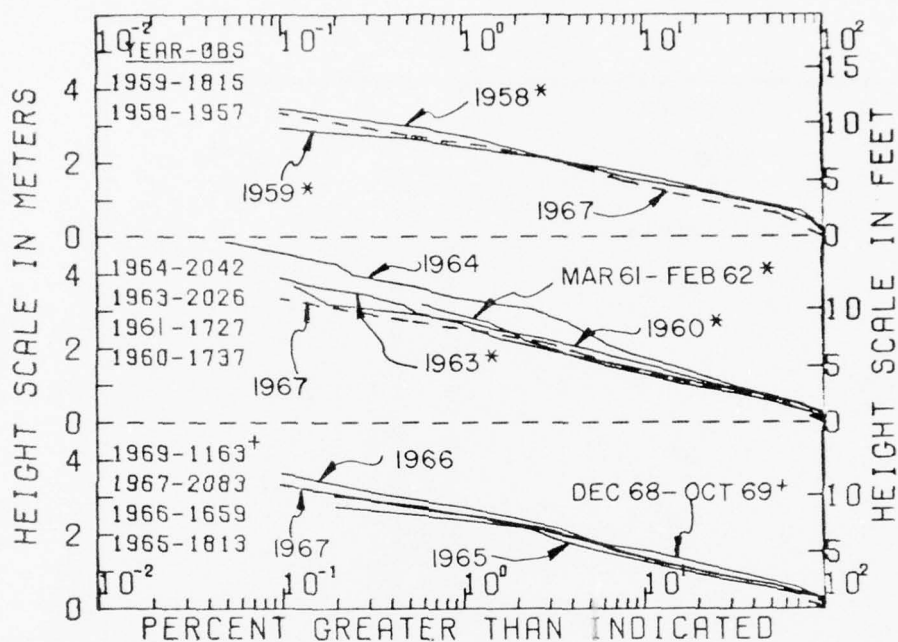


Figure A-8. Means and standard deviations of wave periods for Atlantic City, New Jersey.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Tables A-7 and A-8).

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-9. Annual cumulative significant height distributions from Atlantic City, New Jersey.

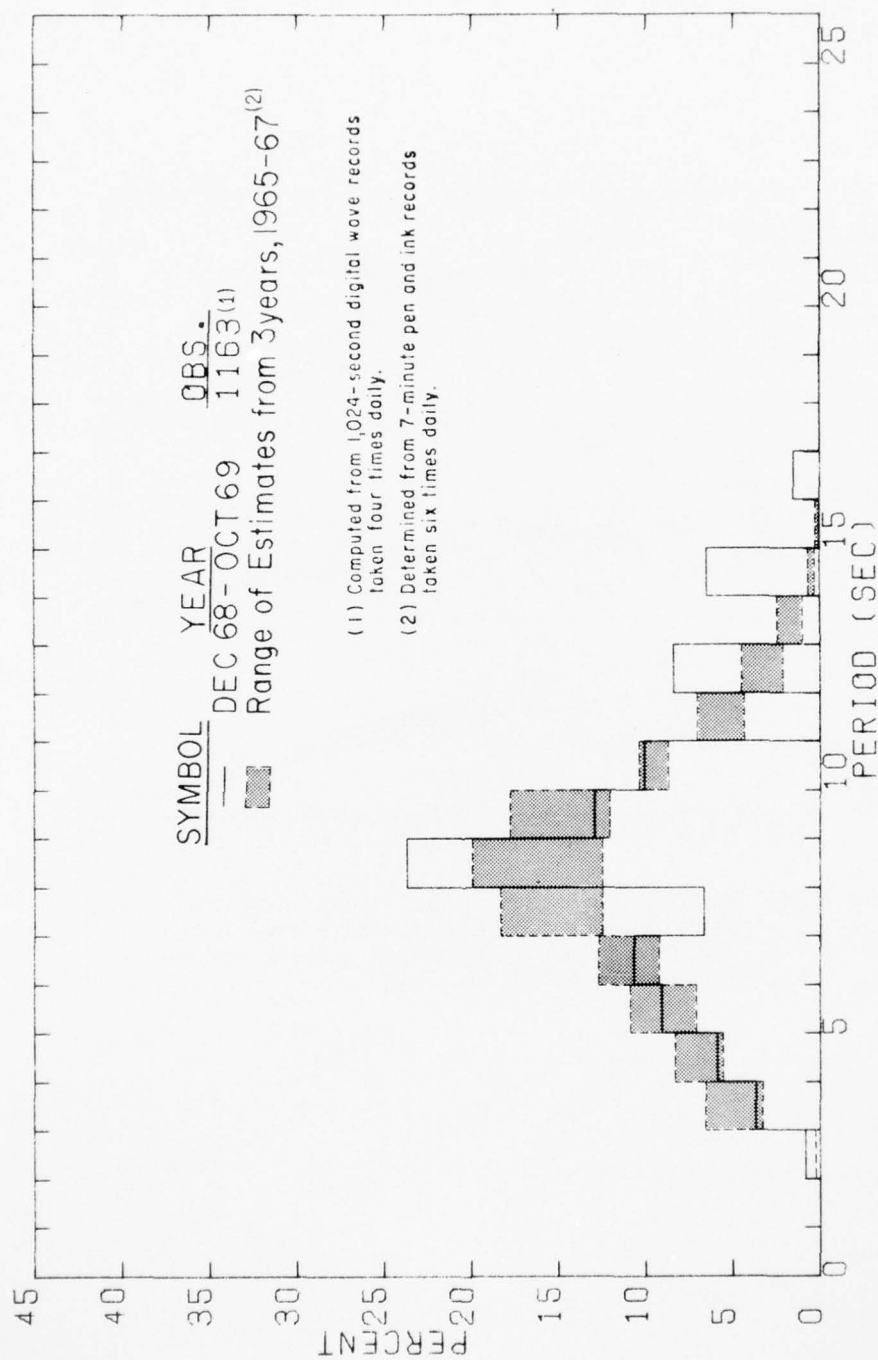


Figure A-10. Annual significant period distributions from Atlantic City, New Jersey.

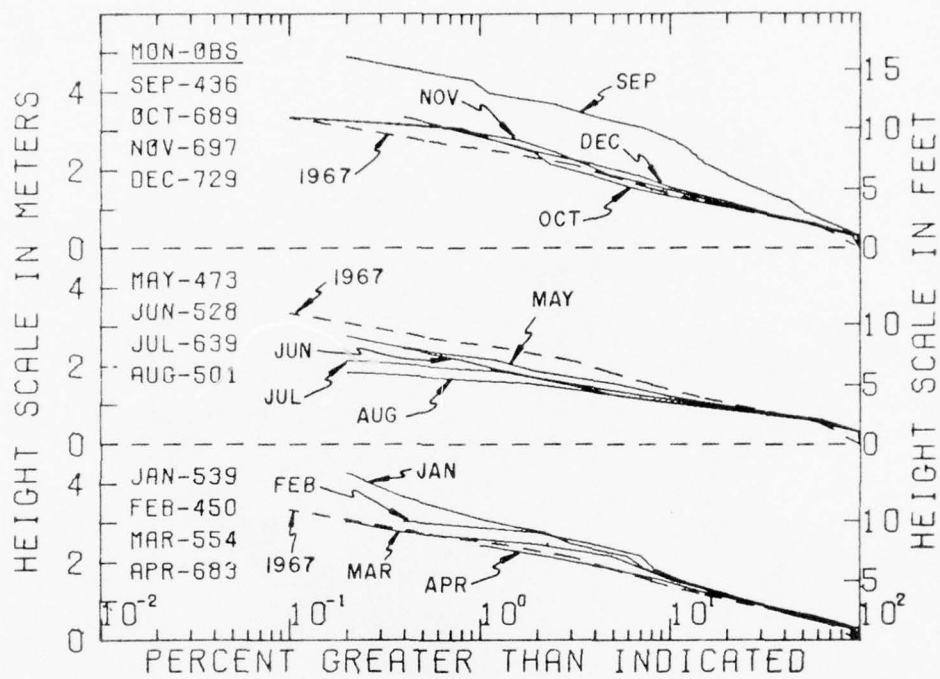


Figure A-11. Seasonal summaries of cumulative significant height distributions from Atlantic City, New Jersey; determined from 7-minute pen and ink records taken six times daily.

Table A-6. Wave climate for Atlantic City, New Jersey.
Distribution of significant height versus period
(in observations per 1,000 observations).

539 OBSERVATIONS SUMMARY FOR JAN 65 JAN 66 JAN 67

PERIOD (SECS)	HEIGHT (FT)														CUM. NO.	RD.
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	12=13	13=	TOT.	AVG.
1.0 = 1.9	6														1000	.00
2.0 = 2.9		2													2	1000 .00
2.5 = 2.9															2	1000 .00
3.0 = 3.9	7	13	2												22	998 1.25
3.5 = 3.9															15	976 1.42
4.0 = 4.9	2	14	20	7	2										50	961 2.28
5.0 = 5.9	9	15	11	19	11	7									73	910 2.91
6.0 = 6.9	7	22	4	20	22	4		2							62	816 3.09
7.0 = 7.9	9	45	24	17	9	7	4	11			4				151	756 3.20
8.0 = 8.9	11	46	20	4	6	6	2	2							104	675 2.59
9.0 = 9.9	13	67	14	8	7	4	4	4	4	4	2				158	521 2.85
10.0 = 10.9	19	92	26	11	9	7	4	4	4	2	6				144	382 3.31
11.0 = 11.9	15	31	28	4	7	4		2					2	2	91	233 2.39
12.0 = 12.9	4	50	6		2										47	142 1.53
13.0 = 13.9	11	33	9	2											56	75 1.53
14.0 = 14.9	4	7	4												18	19 1.68
TOTAL	128	410	173	102	76	39	15	28	9	11	7			2		
CUM. TOTAL	1000	872	462	289	187	111	72	59	32	22	11			4	4	2
COL. AVG.	9.36	9.40	8.75	7.88	7.99	8.31	8.50	8.77	10.10	8.83	10.25			10.90	10.50	8.96

AVERAGE SIG. HEIGHT = 2.43 FT
VARIANCE OF SIG. HEIGHT = 4.35 FT SQ
STANDARD DEVIATION OF HEIGHT = 2.08 FT

AVERAGE WAVE PERIOD = 8.96 SEC
VARIANCE OF WAVE PERIOD = 7.43 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.73 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDER TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT STEEL PIER
* CALMS ARE OMITTED.

450 OBSERVATIONS		SUMMARY FOR FEB 65 FEB 66 FEB 67															
PERIOD (SECS)	HEIGHT (FT)															CUM.	NO.
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	TOT.*	TOT.*	AVG.*			
0 = 1.9	2													1000	.00		
0 = 2.4														1000	.00		
5 = 2.9	2													2	1000 .50		
0 = 3.4		33												33	998 1.50		
5 = 3.9		16	7											22	964 1.80		
0 = 4.9		38	20	7										65	942 2.02		
0 = 5.9	4	27	24	22	7	4								89	878 2.65		
0 = 6.9	9	22	38	16	13	7		7						111	788 3.00		
0 = 7.9	13	20	22	20	13	7	2	4	2					105	677 3.12		
0 = 8.9	7	49	33	20	11	2	2	9	2					136	572 2.89		
0 = 9.9	11	58	36	13	7	4	2	2	4	4	2			140	437 2.66		
0 = 10.9	9	36	20	7	4	2	4	4	4	7	2			105	296 3.71		
0 = 11.9	9	44	16	4	2	4		4	2					91	192 2.79		
0 = 12.9		42	4	4							2	2		56	100 2.42		
0 = 13.9	7	7	7											22	45 1.80		
0 = 14.9	11	11			2									22	22 1.00		
TOTAL	84	402	227	113	60	31	11	31	20	16	4						
CUM. TOTAL	1000	916	513	287	173	113	82	71	40	20	4						
COL. AVG.	9.70	8.47	8.02	7.74	8.06	8.14	9.30	8.71	9.83	10.93	11.50			8.44			

AVERAGE SIG. HEIGHT = 2.72 FT
VARIANCE OF SIG. HEIGHT = 4.05 FT SQ
STANDARD DEVIATION OF HEIGHT = 2.01 FT

AVERAGE WAVE PERIOD = 8.44 SEC
VARIANCE OF WAVE PERIOD = 7.51 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.74 SEC

550 OBSERVATIONS

SUMMARY FOR MAR 65 MAR 66 MAR 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	TOT.*	CUM.*	RD*	AVG.*
1.0 = 1.9													1000	1.00	
2.0 = 2.9													1000	1.00	
2.5 = 2.9													1000	1.00	
3.0 = 3.9	2	22	5										29	1000	1.62
3.5 = 3.9	5	14	7	2									29	971	1.69
4.0 = 4.9		29	23	9									61	942	2.18
5.0 = 5.9	2	20	20	14	14	4	2						76	881	3.00
6.0 = 6.9	11	22	25	27	16	4	2						106	805	2.82
7.0 = 7.9	7	47	32	25	14	4	9	4	4				146	699	3.04
8.0 = 8.9	5	67	31	18	13	9		4	2				148	552	2.65
9.0 = 9.9	7	67	38	13	11	4	7	9					155	404	2.74
10.0 = 10.9	9	67	25	7	5	4	2	11	5				155	249	2.62
11.0 = 11.9	11	13	13	7	2	2		2	5	2			56	94	3.15
12.0 = 12.9	7	9	15	2	2	2					2		36	38	2.55
13.0 = 13.9		2											2	2	1.50
TOTAL	67	397	235	125	78	31	22	29	16	2	2				2.70
CUM. TOTAL	1000	933	536	303	179	101	70	49	20	4	2				
COL. AVG.	8.76*	8.19	7.97	7.61	7.78	8.56	8.17	9.62	9.94	11.50	12.50	8.17			

AVERAGE SIG. HEIGHT = 2.70 FT

AVERAGE WAVE PERIOD = 8.17 SEC*

VARIANCE OF SIG. HEIGHT = 3.19 FT SQ

VARIANCE OF WAVE PERIOD = 5.48 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.79 FT

STANDARD DEVIATION OF PERIOD = 2.34 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT STEEL PIER
 * CALMS ARE OMITTED.

663 OBSERVATIONS

SUMMARY FOR APR 64 APR 65 APR 66 APR 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM.*	RD*	AVG.*
1.0 = 1.9											1000	1.00	
2.0 = 2.9	1										1	1000	1.50
2.5 = 2.9		3									3	999	1.50
3.0 = 3.9	4	13	3								20	994	1.43
3.5 = 3.9	3	24	14	1							47	975	1.84
4.0 = 4.9	1	16	25	18							60	928	2.08
5.0 = 5.9	3	13	41	20	15	6	3				101	868	3.09
6.0 = 6.9		37	34	19	12	10	6				117	747	3.01
7.0 = 7.9	3	67	45	25	15	6	6		3		170	650	2.73
8.0 = 8.9		72	47	22	6	10	3	7	4		171	480	2.89
9.0 = 9.9	1	70	31	20	9	7	4	1	1		146	309	2.64
10.0 = 10.9	3	29	13	10	1	1		1	1		61	163	2.48
11.0 = 11.9		28	12	6		1	1				50	101	2.41
12.0 = 12.9		9	13	1	1	1	1				28	51	2.71
13.0 = 13.9	1	9	4	1	3						19	23	2.27
14.0 = 14.9		1	3								4	4	2.17
TOTAL	22	394	287	105	61	44	25	12	10				2.68
CUM. TOTAL	1000	978	584	297	152	91	47	22	10				
COL. AVG.	8.27*	8.11	7.65	7.60	7.69	7.97	8.03	9.25	8.64	7.84			

AVERAGE SIG. HEIGHT = 2.68 FT

AVERAGE WAVE PERIOD = 7.85 SEC*

VARIANCE OF SIG. HEIGHT = 2.30 FT SQ

VARIANCE OF WAVE PERIOD = 9.78 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.51 FT

STANDARD DEVIATION OF PERIOD = 2.40 SEC*

473 OBSERVATIONS

SUMMARY FOR MAY 65 MAY 66 MAY 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.9	4											1000	1.00
2.0 = 2.4		2									2	1000	1.50
2.5 = 2.9												998	1.00
3.0 = 3.4			4								4	998	2.00
3.5 = 3.9		21	17	2							40	989	2.03
4.0 = 4.9		27	55	6							91	949	2.31
5.0 = 5.9		80	42	27	13	4					168	858	2.41
6.0 = 6.9		42	55	8	6	8	2		2		125	690	2.70
7.0 = 7.9		89	70	21	6	2	2	2			191	565	2.30
8.0 = 8.9		82	53	25	13	4	2	2			183	374	2.50
9.0 = 9.9		61	27	27	6	4	4	2		2	136	191	2.75
10.0 = 10.9	2	21	6	4		6		2			42	55	2.70
11.0 = 11.9		2	2		2						6	13	2.83
12.0 = 12.9		4	2								6	6	1.83
TOTAL	6	438	334	123	49	30	8	8	2	2			2.46
CUM. TOTAL	1000	994	556	222	99	51	21	13	4	2			
COL. AVG.	10.50*	7.28	6.78	7.52	7.41	8.00	8.50	9.00	8.50	9.50	7.21		

AVERAGE SIG. HEIGHT = 2.46 FT

AVERAGE WAVE PERIOD = 7.21 SEC*

VARIANCE OF SIG. HEIGHT = 1.97 FT SQ

VARIANCE OF WAVE PERIOD = 3.68 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.25 FT

STANDARD DEVIATION OF PERIOD = 1.92 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT STEEL PIER

* CALMS ARE OMITTED.

528 OBSERVATIONS

SUMMARY FOR JUN 64

JUN 66 JUN 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.9												1000	1.00
2.0 = 2.4		2									2	1000	1.00
2.5 = 2.9												998	1.00
3.0 = 3.4		8	2								9	998	1.70
3.5 = 3.9		25	4								28	989	1.63
4.0 = 4.9		32	42	4	2						78	960	2.23
5.0 = 5.9		81	100	17	4						98	883	2.46
6.0 = 6.9	2	57	61	6	6	2					133	784	2.21
7.0 = 7.9	4	81	100	17	2	8					212	652	2.29
8.0 = 8.9	8	112	93	34	4		4				254	139	2.22
9.0 = 9.9	8	86	30	13	4			2	2		125	86	2.18
10.0 = 10.9		13	6	8		2					28	61	2.50
11.0 = 11.9		6	6				2			2	15	32	3.37
12.0 = 12.9		2		4	2			2			9	17	4.10
13.0 = 13.9		2			4						8	8	4.00
TOTAL	21	434	386	106	27	13	6	4	4	4			2.29
CUM. TOTAL	1000	979	545	159	53	27	13	8	4				
COL. AVG.	8.50*	7.47	7.23	7.91	8.43	8.64	9.50	11.00	10.50	7.52			

AVERAGE SIG. HEIGHT = 2.29 FT

AVERAGE WAVE PERIOD = 7.52 SEC*

VARIANCE OF SIG. HEIGHT = 1.13 FT SQ

VARIANCE OF WAVE PERIOD = 3.60 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.06 FT

STANDARD DEVIATION OF PERIOD = 1.90 SEC*

639 OBSERVATIONS

SUMMARY FOR JUL 64 JUL 65 JUL 66 JUL 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM.*	ROW
1.0 = 1.9	2									1000	.00
2.0 = 2.9										1000	.00
2.5 = 2.9										1000	.00
3.0 = 3.9		6							6	1000	1.50
3.5 = 3.9		8	6	5					19	994	2.33
4.0 = 4.9		13	19	3					34	975	2.23
5.0 = 5.9		14	23	8	5	3			53	940	2.74
6.0 = 6.9		47	56	25	11	2			141	887	2.53
7.0 = 7.9		116	116	34	9	5	3		284	746	2.37
8.0 = 8.9		100	117	41	8	3	5	2	276	462	2.47
9.0 = 9.9		45	53	19	6		3		127	187	2.49
10.0 = 10.9	2	13	11	8	2	2			36	60	2.50
11.0 = 11.9			6			2			8	24	3.10
12.0 = 12.9			2		3				5	16	3.83
13.0 = 13.9		2							2	11	1.50
14.0 = 14.9		2	3	2	3				9	9	3.17
TOTAL	3	365	413	144	47	16	11	2			2.47
CUM. TOTAL	1000	997	632	219	75	28	13	2			
COL. AVG.	10.50*	7.72	7.81	7.81	8.40	7.90	8.50	8.50	7.82		

AVERAGE SIG. HEIGHT = 2.47 FT

AVERAGE WAVE PERIOD = 7.82 SEC*

VARIANCE OF SIG. HEIGHT = 1.06 FT SQ

VARIANCE OF WAVE PERIOD = 2.81 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.03 FT

STANDARD DEVIATION OF PERIOD = 1.68 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT STEEL PIER

* CALMS ARE OMITTED.

501 OBSERVATIONS

SUMMARY FOR AUG 64 AUG 65 AUG 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM.*	ROW
1.0 = 1.9									1000	.00
2.0 = 2.9									1000	.00
2.5 = 2.9									1000	.00
3.0 = 3.9			2					2	1000	2.50
3.5 = 3.9	2	6	12					20	998	2.00
4.0 = 4.9		34	44	8				86	978	2.70
5.0 = 5.9		32	66	30	12			140	892	2.66
6.0 = 6.9	2	70	78	26	12	10		198	752	2.53
7.0 = 7.9		98	104	16	4	2	2	226	554	2.23
8.0 = 8.9	6	48	60	22	2			138	329	2.25
9.0 = 9.9	6	44	32	8				90	192	1.97
10.0 = 10.9		18	22	4	4	2		50	102	2.50
11.0 = 11.9		6	4	6	2	2		20	52	3.00
12.0 = 12.9		2	2	2	2			8	32	3.00
13.0 = 13.9	2	4	4					10	24	1.70
14.0 = 14.9	6	4	2	2				14	14	1.50
TOTAL	24	345	431	124	38	16	2			2.34
CUM. TOTAL	1000	976	611	180	56	18	2			
COL. AVG.	10.10*	7.55	7.17	7.40	7.39	7.75	7.50	7.43		

AVERAGE SIG. HEIGHT = 2.34 FT

AVERAGE WAVE PERIOD = 7.43 SEC*

VARIANCE OF SIG. HEIGHT = .89 FT SQ

VARIANCE OF WAVE PERIOD = 4.35 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .94 FT

STANDARD DEVIATION OF PERIOD = 2.09 SEC*

BEST AVAILABLE COPY

434 OBSERVATIONS														SUMMARY FOR SEP 64 SEP 65 SEP 67			
PERIOD (SECS)														HEIGHT (FT)			
0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	12=13	13 +	TOT.	CUM.	ROW	AVG.
1.0 = 1.9															1000	1.00	
2.0 = 2.8															1000	1.00	
2.5 = 2.9															1000	1.00	
3.0 = 3.8															1000	1.00	
3.5 = 3.9															1000	1.50	
4.0 = 4.9															26	991	1.67
5.0 = 5.9															34	963	2.03
6.0 = 6.9															49	929	2.83
7.0 = 7.9															67	860	3.13
8.0 = 8.9															131	794	3.54
9.0 = 9.9															131	663	3.28
10.0 = 10.9															151	532	3.38
11.0 = 11.9															115	381	3.38
12.0 = 12.9															78	266	4.38
13.0 = 13.9															55	180	6.79
14.0 = 14.9															42	133	7.94
15.0 = 15.9															50	71	8.09
16.0 = 16.9															4	211.00	
TOTAL	7	264	204	92	131	85	48	23	25	30	14	14	11	11	11	6.50	4.13
CUM. TOTAL	1000	993	709	505	413	282	200	151	126	103	73	59	25	11			
COL. AVG.	9.83*	8.06	8.65	8.30	8.85	10.53	10.98	11.60	10.32	11.50	13.23	13.67	13.83	14.30	9.32		
AVERAGE SIG. HEIGHT = 4.13 FT														AVERAGE WAVE PERIOD = 0.32 SEC			
VARIANCE OF SIG. HEIGHT = 8.80 FT SQ														VARIANCE OF WAVE PERIOD = 0.51 SEC SQ			
STANDARD DEVIATION OF HEIGHT = 2.97 FT														STANDARD DEVIATION OF PERIOD = 2.92 SEC			
RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY																	
WAVE GAGE LOCATED AT STEEL PIER																	
* CALMS ARE OMITTED.																	

689 OBSERVATIONS														SUMMARY FOR OCT 64 OCT 65 OCT 66 OCT 67			
PERIOD (SECS)														HEIGHT (FT)			
0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT.	CUM.	ROW	AVG.		
1.0 = 1.9													1000	1.00			
2.0 = 2.8													1000	1.00			
3.0 = 2.9													1000	1.00			
4.0 = 3.0													1000	1.00			
5.0 = 3.0													1000	1.00			
6.0 = 4.0	1	13	10										13	1000	1.50		
7.0 = 5.0	3	19											30	987	1.79		
8.0 = 4.0	3	28	32	9	1								73	946	2.20		
9.0 = 5.0	4	20	15			4	3						65	884	2.79		
10.0 = 6.0	4	23	9	12	10	12	3	1	1				73	819	3.44		
11.0 = 7.0	4	18	38	29	10	3	1	1		1			126	746	2.79		
12.0 = 8.0	6	81	65	46	10	8	3	1	1				218	620	2.53		
13.0 = 9.0	9	115	64	33	17	4		3	3				235	402	2.33		
14.0 = 10.0	1	55	22	6	1	1	3	3		1	4		100	107	2.76		
15.0 = 11.0	3	25	7	3						1	3	1	44	67	3.03		
16.0 = 12.0	1	4	9	1									16	23	1.18		
17.0 = 13.0	1	1											3	7	1.00		
18.0 = 14.0	4												8	6	1.50		
TOTAL	41	421	270	144	60	25	16	8	7	8	7	1			2.37		
CUM. TOTAL	1000	959	538	269	125	65	41	25	20	13	6	1					
COL. AVG.	4.01	8.28	8.09	7.43	8.18	7.03	7.45	6.17	6.30	6.83	10.90	11.50	8.20				
AVERAGE SIG. HEIGHT = 2.57 FT														AVERAGE WAVE PERIOD = 8.20 SEC			
VARIANCE OF SIG. HEIGHT = 2.00 FT SQ														VARIANCE OF WAVE PERIOD = 8.66 SEC SQ			
STANDARD DEVIATION OF HEIGHT = 1.41 FT														STANDARD DEVIATION OF PERIOD = 2.15 SEC			

BEST AVAILABLE COPY

697 OBSERVATIONS SUMMARY FOR NOV 64 NOV 65 NOV 66 NOV 67

PERIOD (SECS)	HEIGHT (FT)												CUM. NO.	TOT. #	AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT. #		
1.0 = 1.9	36												36	1000	1.00
2.0 = 2.9		6											6	1000	1.00
3.0 = 3.9	3	19											22	999	1.37
4.0 = 4.9	1	10	4										15	955	2.60
5.0 = 5.9		14	23	17	1								42	897	3.08
6.0 = 6.9	3	17	24	13	10	10	1						113	815	3.16
7.0 = 7.9	1	34	33	6	11	10	4	1	1				115	702	2.67
8.0 = 8.9	4	34	40	17	9	1	1		3				140	588	2.61
9.0 = 9.9	4	42	36	16	8	4	4			4			190	448	2.45
10.0 = 10.9	10	73	53	23	16	7	1	1			1	1	110	257	2.49
11.0 = 11.9	10	46	24	14	8	1	1	1					73	147	3.77
12.0 = 12.9	4	11	22	7	3	3	1	6	3	1			48	74	2.81
13.0 = 13.9	7	4	19	11	1				1	1			16	27	3.59
14.0 = 14.9	1	1	4	5	4								9	18	2.17
15.0 = 15.9	1	3	3	1									1	1	1.00
TOTAL	92	337	286	128	66	43	14	10	9	9	6	1			2.65
CUM. TOTAL	1000	908	571	246	158	92	49	34	24	16	7	1			
COL. AVG.	4.62	8.09	4.46	6.66	6.92	7.47	8.00	10.34	9.50	10.50	11.25	10.50			8.42

AVERAGE SIG. HEIGHT = 2.65 FT AVERAGE WAVE PERIOD = 8.42 SECS
 VARIANCE OF SIG. HEIGHT = 3.16 FT SQ VARIANCE OF WAVE PERIOD = 4.26 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.78 FT STANDARD DEVIATION OF PERIOD = 2.50 SECS

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT STEEL PIER
 * CALMS ARE OMITTED.

729 OBSERVATIONS SUMMARY FOR DEC 64 DEC 65 DEC 66 DEC 67

PERIOD (SECS)	HEIGHT (FT)												CUM. NO.	TOT. #	AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT. #		
1.0 = 1.9	32												32	1000	1.00
2.0 = 2.9	1	1											2	997	1.00
3.0 = 3.9	3	16											19	907	1.36
4.0 = 4.9	4	16	4										24	877	1.50
5.0 = 5.9	1	22	21	7									52	852	2.15
6.0 = 6.9		19	18	10	8	4							61	890	2.63
7.0 = 7.9	1	21	15	14	14	4	7	5					76	819	3.60
8.0 = 8.9		22	16	10	11	5	4	3	1	1			76	744	3.50
9.0 = 9.9	4	51	37	12	10		7	4	1	1			132	667	2.80
10.0 = 10.9	7	69	34	14	7	6	7	5	5	4			169	535	3.18
11.0 = 11.9	15	60	34	18	11	3	4	1		1			153	367	2.44
12.0 = 12.9	7	41	25	5	7	3	1						93	214	2.34
13.0 = 13.9	3	32	23	8	3								67	120	2.12
14.0 = 14.9	1	15	8	5	1	1							34	54	2.33
15.0 = 15.9	1	3	1	5	5	3							18	20	3.73
TOTAL	80	388	237	110	80	36	30	19	8	8	4				2.69
CUM. TOTAL	1000	920	532	295	185	106	70	40	21	12	8				
COL. AVG.	4.01	4.88	4.00	6.65	6.69	6.62	6.55	6.21	4.00	4.17	4.00	10.17			6.91

AVERAGE SIG. HEIGHT = 2.69 FT AVERAGE WAVE PERIOD = 6.91 SECS
 VARIANCE OF SIG. HEIGHT = 3.42 FT SQ VARIANCE OF WAVE PERIOD = 7.18 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.85 FT STANDARD DEVIATION OF PERIOD = 2.68 SECS

6918 OBSERVATIONS

SUMMARY FOR 41 MONTHS APR 64 THROUGH DEC 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	12=13	13=14	TOT.	CUM.	ROW
0.0 = 1.9	0															1000	0.00
2.0 = 2.9		1													1	1000	1.00
3.0 = 3.9	2	13	1												16	998	1.48
4.0 = 4.9	2	14	0	1											27	982	1.80
5.0 = 5.9	1	23	28	9	1										41	955	2.28
6.0 = 6.9	2	25	28	16	10	5	1								87	893	2.77
7.0 = 7.9	3	34	34	16	13	7	2	1							113	806	2.64
8.0 = 8.9	4	47	52	21	11	5	3	2	1	1					158	690	2.69
9.0 = 9.9	4	69	53	26	6	4	3	3	1	1					171	536	2.60
10.0 = 10.9	4	67	39	17	9	4	4	3	2	1					154	394	2.64
11.0 = 11.9	4	40	20	9	5	3	1	2	2	1	1				93	211	2.79
12.0 = 12.9	4	19	13	4	3	2	1	2	1	1	1				52	118	2.97
13.0 = 13.9	5	13	9	3	1	1									33	65	2.81
14.0 = 14.9	2	7	3	1	2	1									19	32	3.38
15.0 = 15.9	2	2	2	1	1	1									12	13	3.79
16.0 = 16.9															1	2	4.50
TOTAL	69	387	240	123	64	33	17	14	9	6	4	2	1	1	1	1	2.67
CUM. TOTAL	1000	951	564	274	151	87	54	37	23	14	8	3	2	1			
COL. AVG.	9.13	8.15	7.88	7.93	8.21	8.52	8.80	9.35	9.55	10.01	12.08	12.23	13.36	13.67	8.19		

AVERAGE SIG. HEIGHT = 2.86 FT AVERAGE WAVE PERIOD = 8.18 SEC
 VARIANCE OF SIG. HEIGHT = 3.00 FT SQ VARIANCE OF WAVE PERIOD = 9.91 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.73 FT STANDARD DEVIATION OF PERIOD = 2.43 SEC
 RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT STEEL PIER
 * CALMS ARE OMITTED.

1163 OBSERVATIONS

SUMMARY FOR 11 MONTHS DEC 68 THROUGH OCT 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.	CUM.	ROW
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9	1	4	3								8	1000	1.72
3.0 = 3.9		15	19	3							37	992	2.20
4.0 = 4.9		15	26	18	3						61	955	2.64
5.0 = 5.9		19	29	11	15	15	1	1			91	894	3.33
6.0 = 6.9		13	36	28	18	7	2	3			107	803	3.40
7.0 = 7.9		12	26	14	9	4	2	1			67	696	3.14
8.0 = 8.9	2	71	86	46	15	8	5	3	3		237	629	2.83
9.0 = 9.9	2	45	40	16	13	6	3	1	1	1	127	392	2.80
10.0 = 10.9	3	37	22	19	9	4	2	3	1	1	101	265	2.89
11.0 = 11.9												164	0.00
12.0 = 12.9	1	34	10	14	12	10	2	1	1		84	164	3.09
13.0 = 13.9												80	0.00
14.0 = 14.9	7	22	9	4	5	7	7	4			65	80	3.24
15.0 = 15.9												15	0.00
16.0 = 16.9	3	7	1	1	1			2			15	15	2.32
TOTAL	18	292	307	174	99	62	22	18	6	2			2.86
CUM. TOTAL	1000	982	690	383	209	110	48	26	8	2			
COL. AVG.	12.60	9.15	7.80	8.21	8.69	9.03	10.58	10.64	9.50	10.00	8.63		

AVERAGE SIG. HEIGHT = 2.94 FT AVERAGE WAVE PERIOD = 8.67 SEC
 VARIANCE OF SIG. HEIGHT = 2.32 FT SQ VARIANCE OF WAVE PERIOD = 8.43 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.52 FT STANDARD DEVIATION OF PERIOD = 2.90 SEC
 RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT STEEL PIER
 * CALMS ARE OMITTED.

Table A-7. Comparison of results from different pen and ink wave record analysis methods, Atlantic City, New Jersey.

Dates of data sample reanalyzed by CERC method	Significant heights ¹			Significant periods ²		
	Correlation between heights	A (ft)	B	Correlation between periods	C (s)	D
Oct. to Nov. 1958	0.93	0.47	0.91	0.87	1.68	0.79
Oct. to Nov. 1961	0.88	0.12	0.81	0.66	1.90	0.73
Oct. 1961	0.88	0.19	0.80	0.62	2.87	0.64
Nov. 1961	0.88	0.03	0.83	0.69	1.13	0.79
Jan. to Feb. 1964	0.93	0.23	0.76	0.74	1.37	0.76
Jan. 1964	0.94	0.23	0.76	0.85	1.59	0.76
Feb. 1964	0.91	0.23	0.76	0.67	1.13	0.77

¹Significant height from CERC method
= A + B × (significant height from old method).

²Significant period from CERC method
= C + D × (significant period from old method).

Table A-8. Regression equations used to compensate significant height statistics for Atlantic City, New Jersey.

Date	Compensation equations (ft)
1958 to 1959	$H_{NEW} = 0.47 + 0.91 H_{OLD}$
1960 to Mar. 1964	$H_{NEW} = 0.17 + 0.79 H_{OLD}$
Apr. 1964 to 1971	No compensation

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis.

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

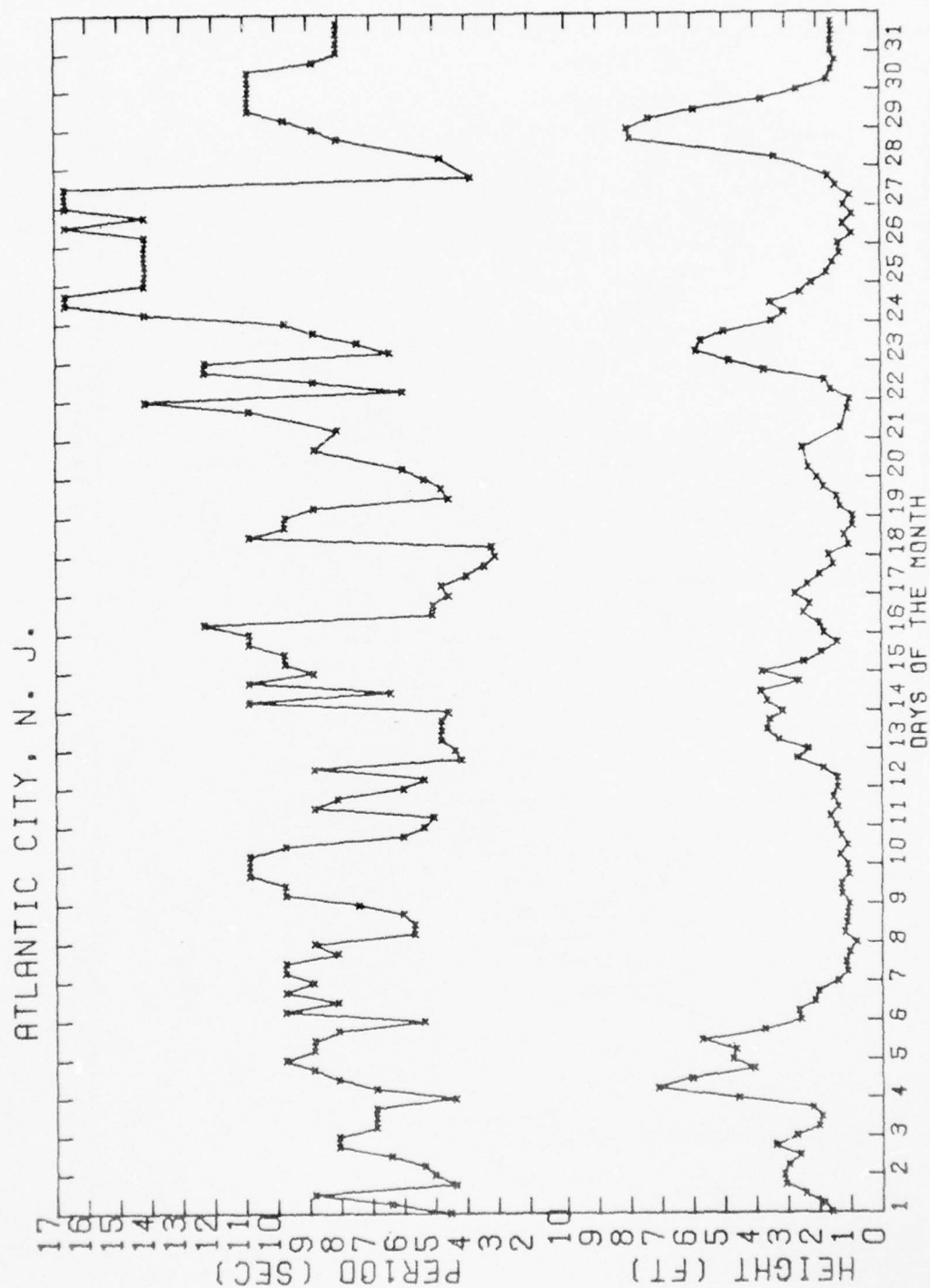


Figure A-12. Time history of significant wave heights and periods, December 1968.

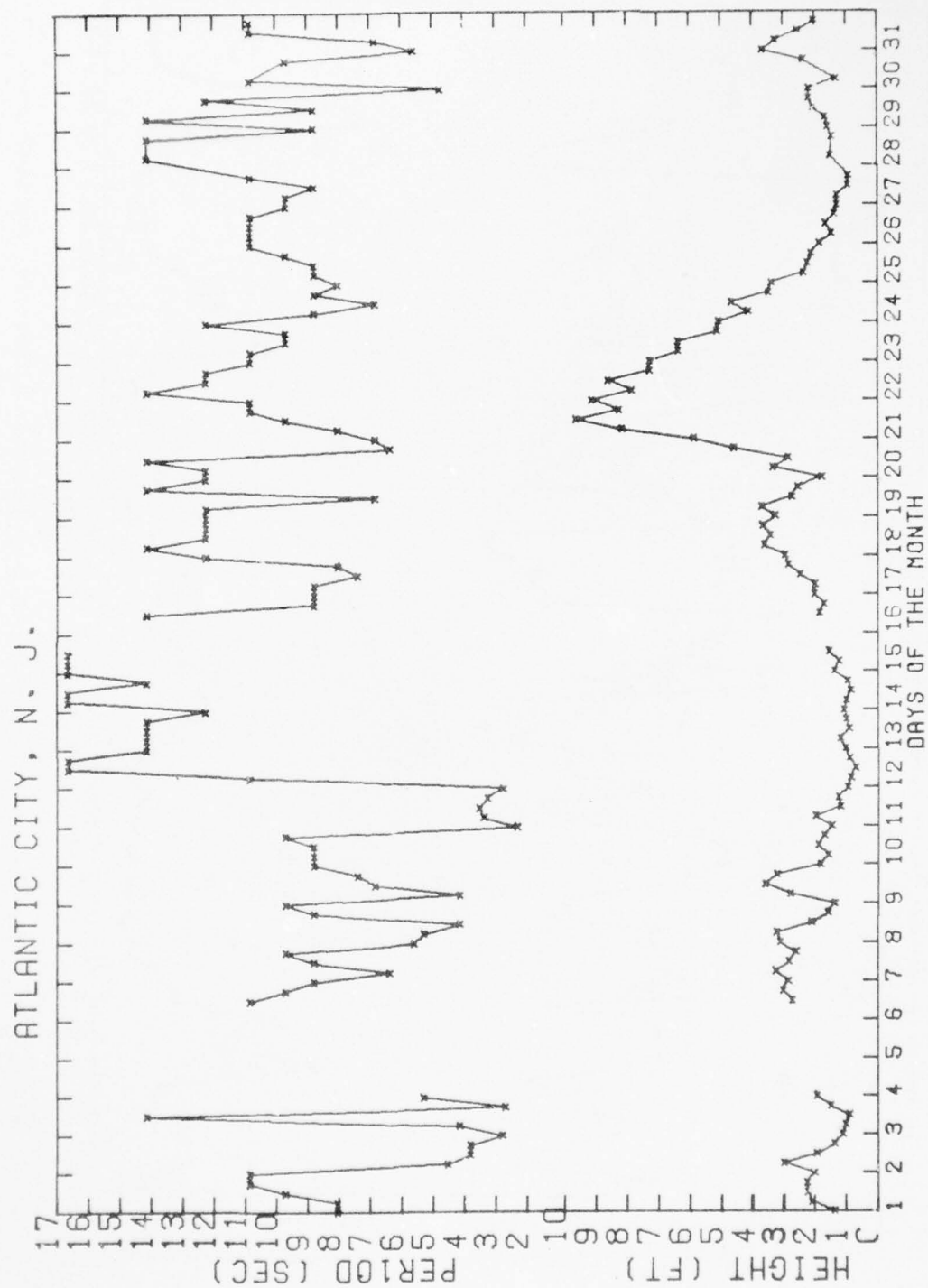


Figure A-13. Time history of significant wave heights and periods, January 1969.

AD-A037 904

COASTAL ENGINEERING RESEARCH CENTER FORT BELVOIR VA
WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS. (U)
JAN 77 E F THOMPSON
CERC-TR-77-1

F/G 8/3

UNCLASSIFIED

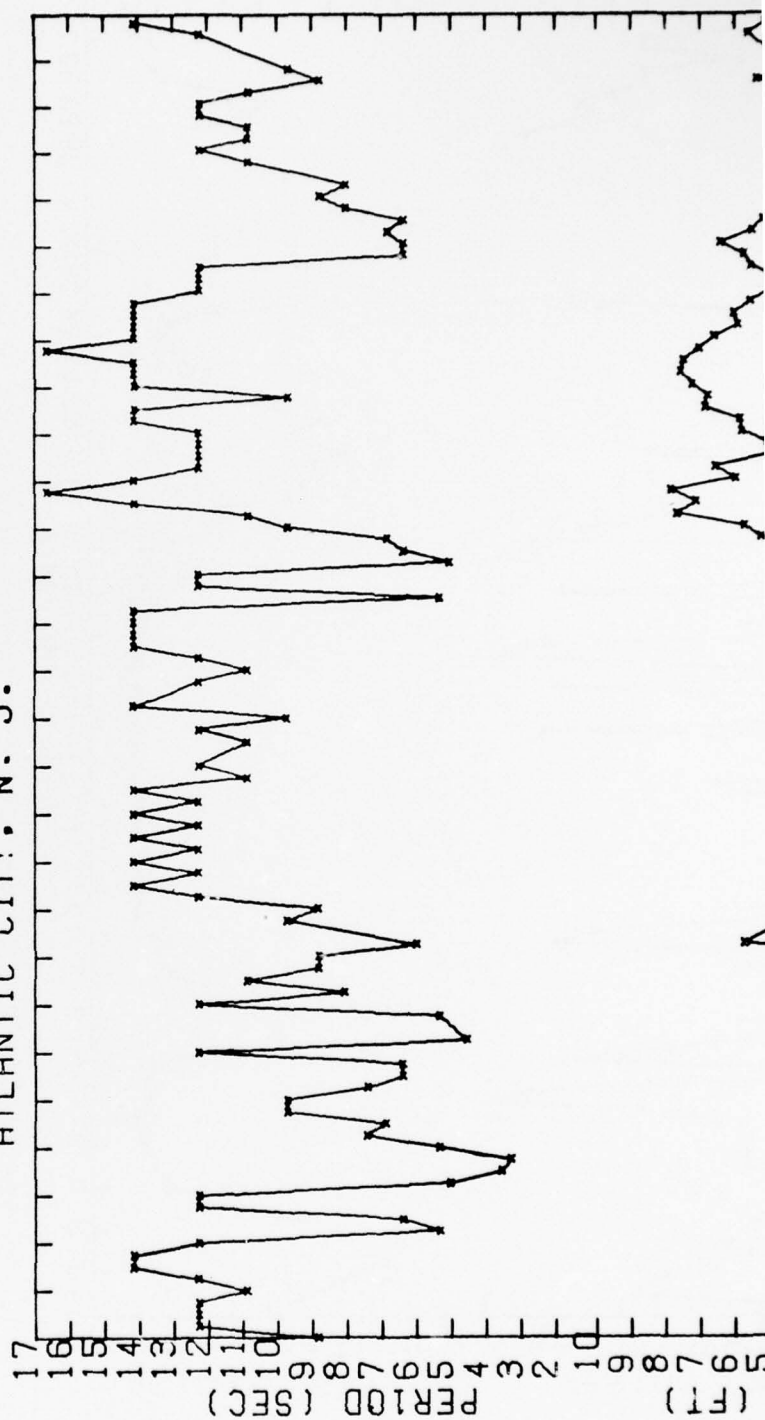
NL

2 OF 4
AD
A037904



04

ATLANTIC CITY, N. J.



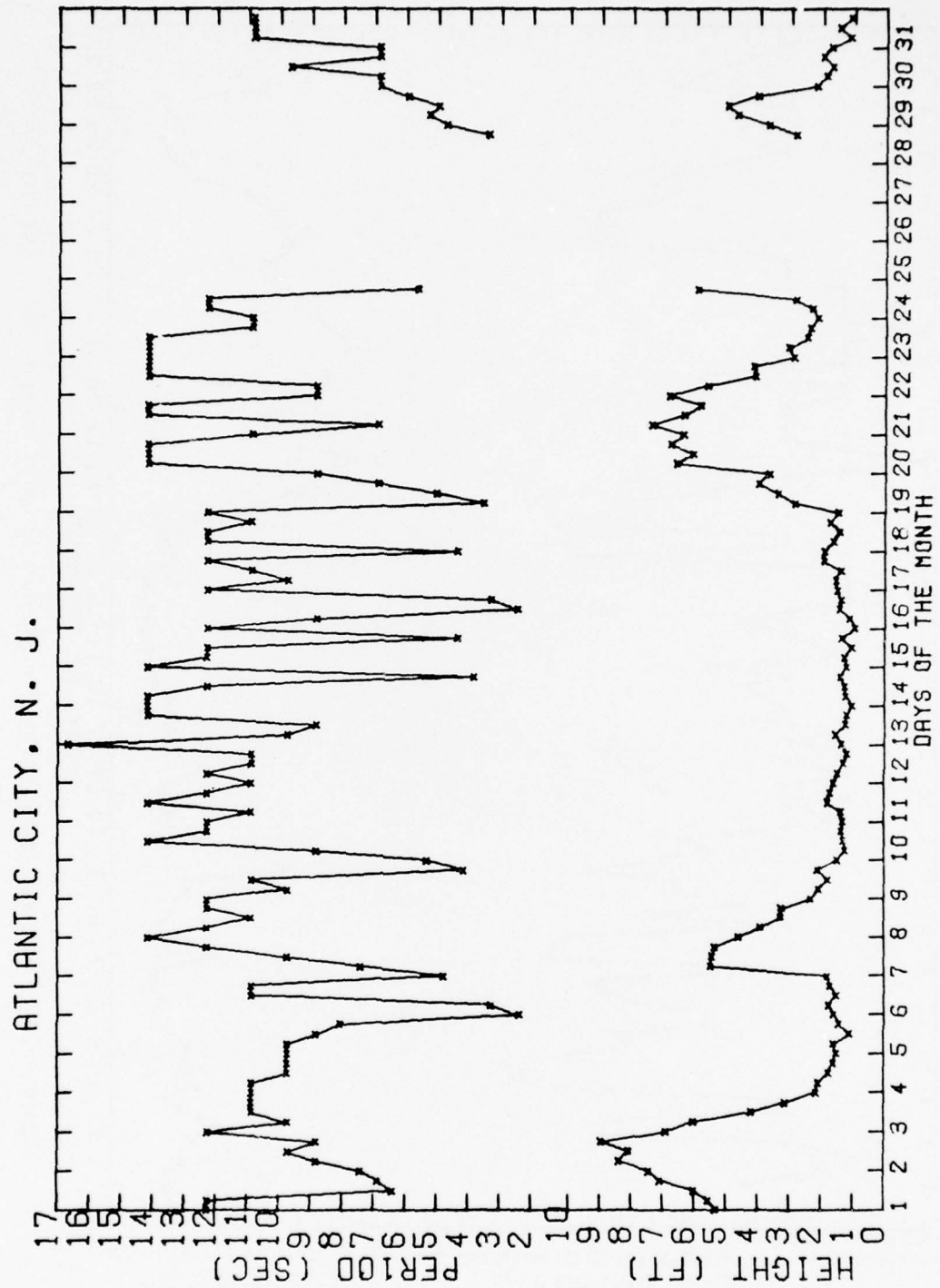
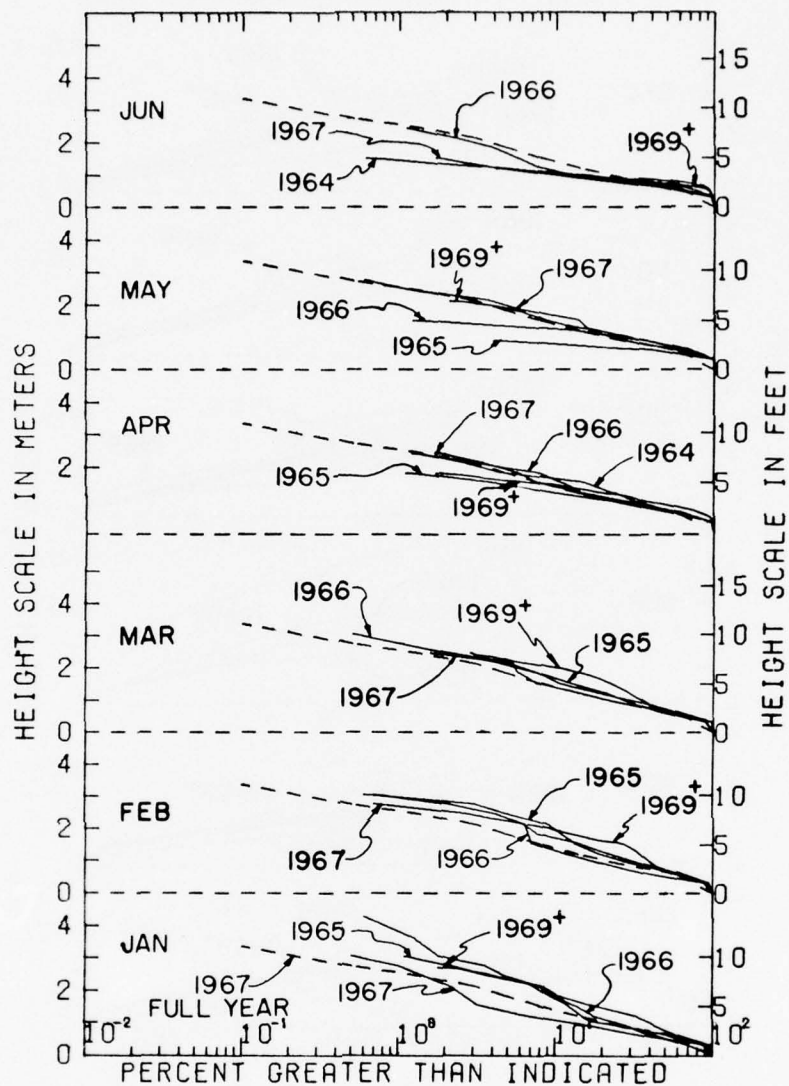


Figure A-15. Time history of significant wave heights and periods, March 1969.

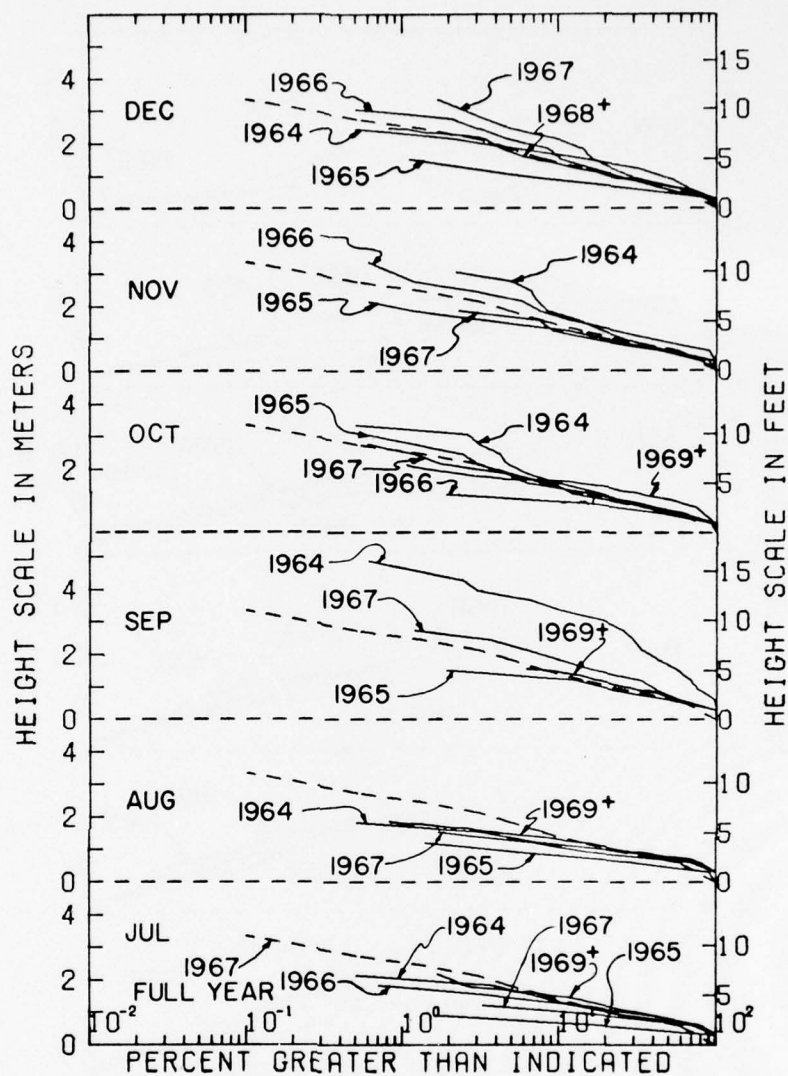


NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-16. Monthly cumulative significant height distributions for Atlantic City, New Jersey.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-17. Monthly cumulative significant height distributions for Atlantic City, New Jersey.

Table A-9. CERC wave gage history for Thimble Shoals Channel, Chesapeake Bay-Bridge Tunnel, Virginia.

CERC Form 174-74
18 Mar 74

COORDINATES: 36°58' N., 76°07' W.

LOCATION: Thimble Shoals Channel, Chesapeake Bay-Bridge Tunnel, Virginia

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance, staff-relay type	28 Mar. 1968	21 Jan. 1970	Ship ran into bridge.	25	-8 to +17	37	0 (on northwest side of pier)	600
	4 Mar. 1970	23 Nov. 1971						
	10 Dec. 1971	18 Oct. 1974	Gage discontinued.					

Table A-10. Number of analyzed digital records from Chesapeake Bay-Bridge Tunnel, Virginia.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1971			37	102	98	83	80	107	102	108	59	82	858
1972	104	116	123	108	120	92	96	112	82	106	80	75	1214
1973	74	70	87	51	44	64	56	90	80	81	84	44	826
1974	84	95	68	61	79	79	55	60	28	41			650

¹From 1,024-second records taken four times daily.

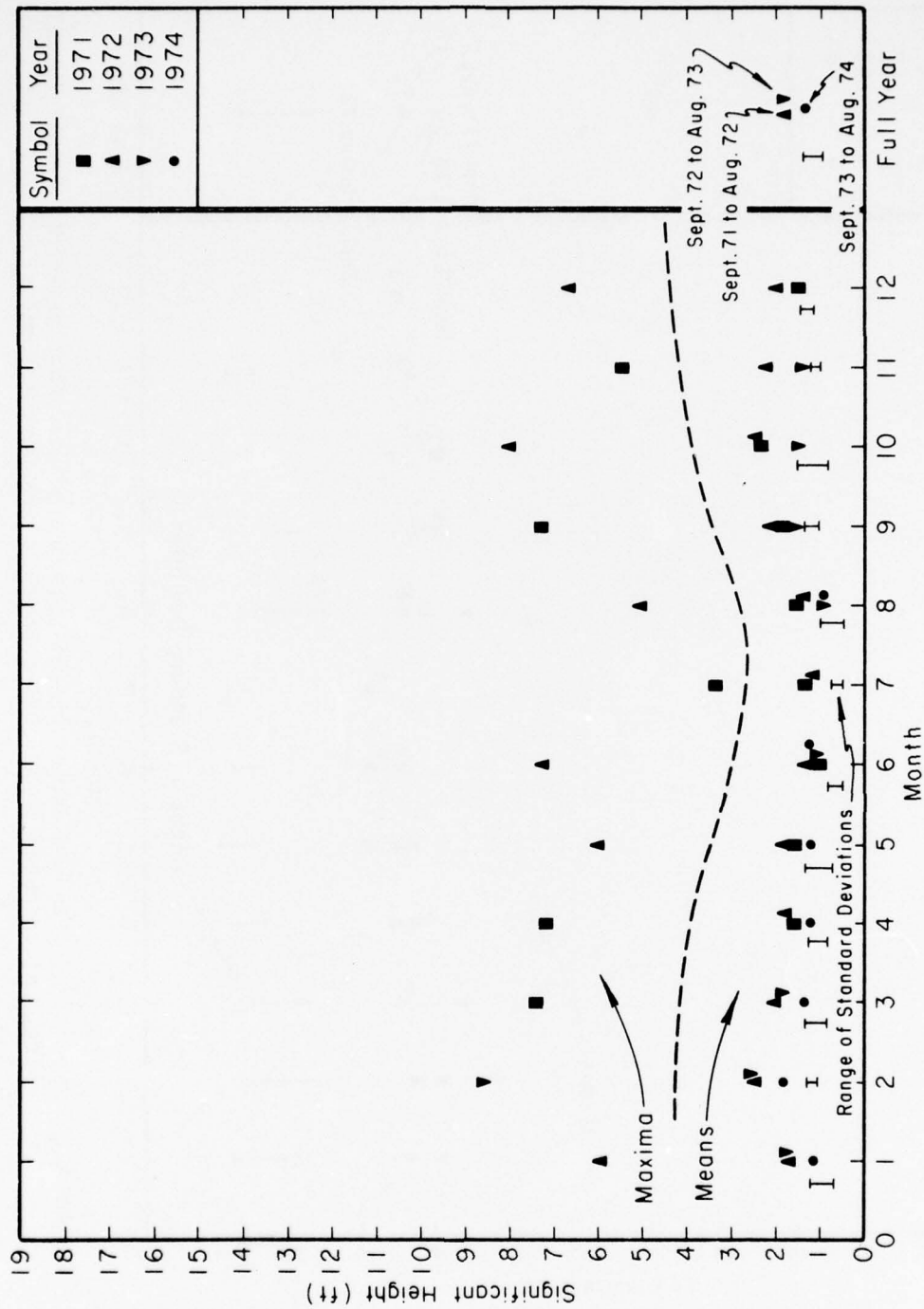


Figure A-18. Maxima, means, and standard deviations of significant height from Chesapeake Bay Bridge-Tunnel, Virginia; computed from 1,024-second digital wave records taken four times daily.

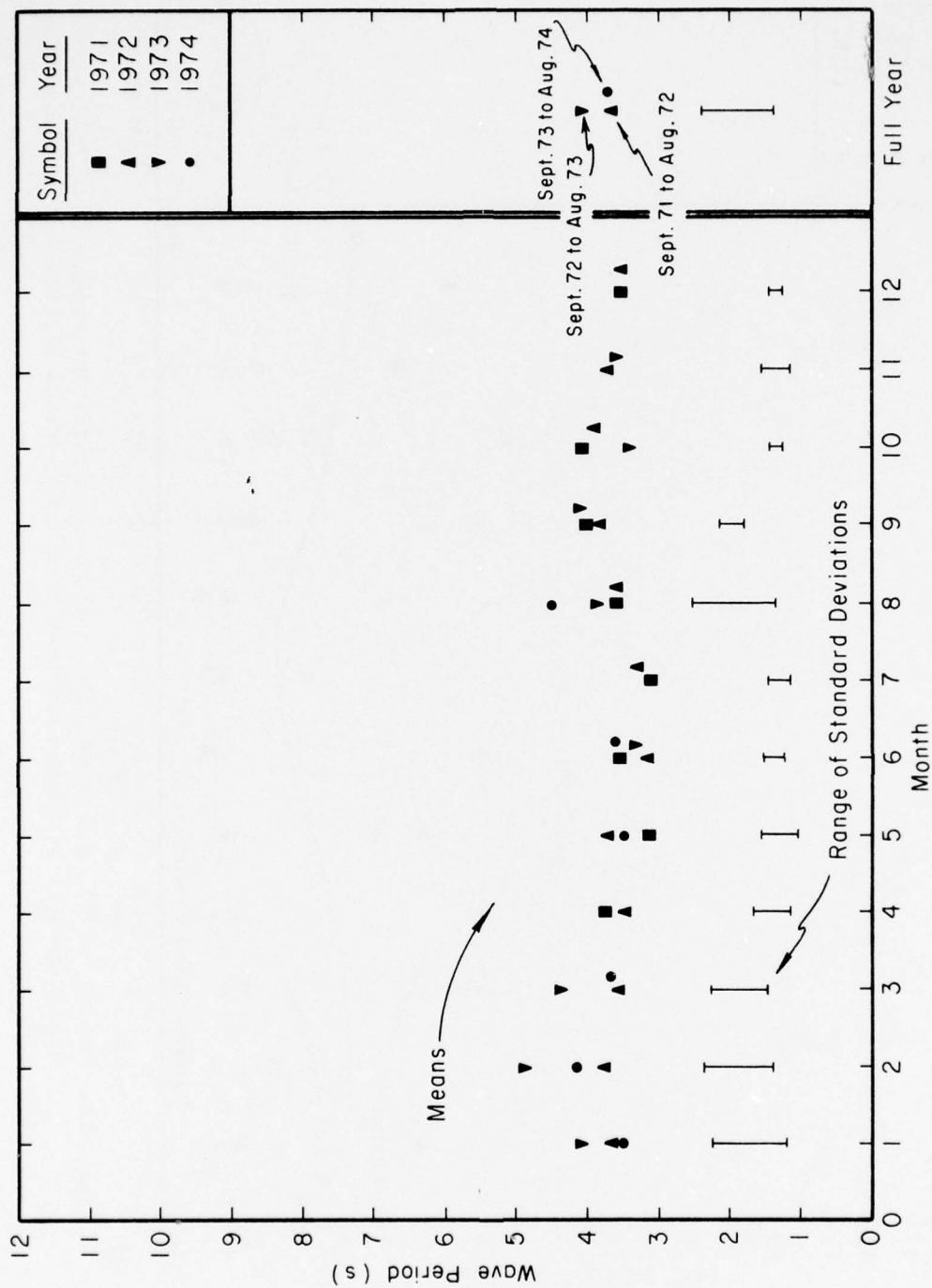
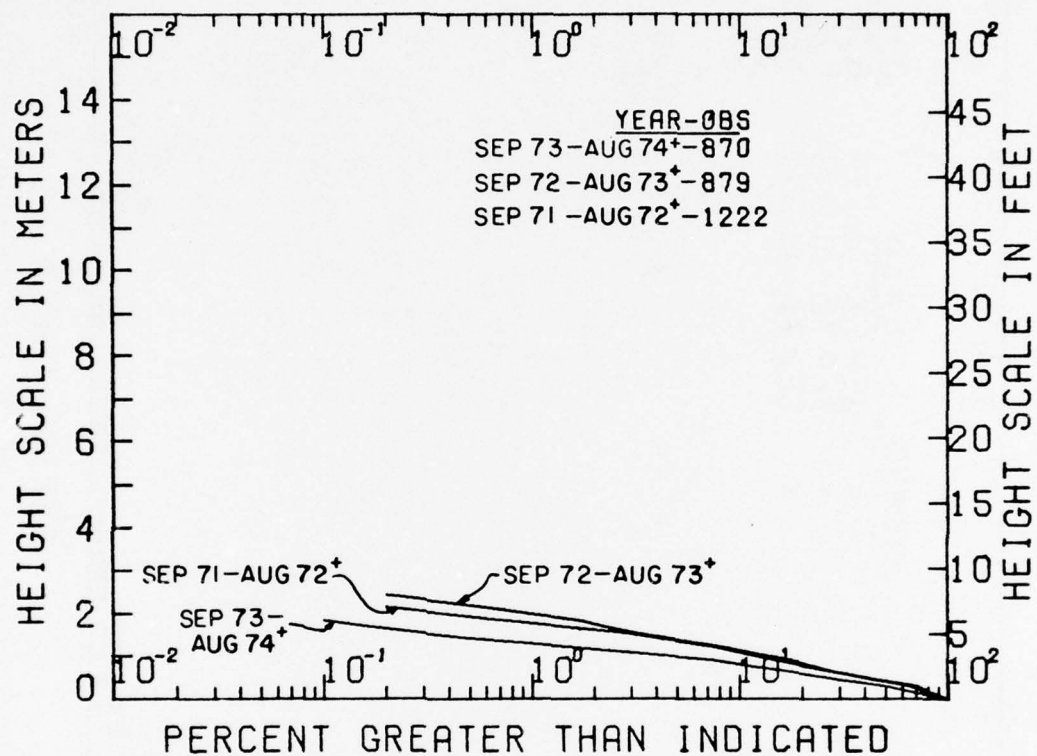


Figure A-19. Means and standard deviations of wave periods for Chesapeake Bay Bridge-Tunnel, Virginia; computed from 1,024-second digital wave records taken four times daily.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Figure A-20. Annual cumulative significant height distributions from Chesapeake Bay Bridge-Tunnel, Virginia.

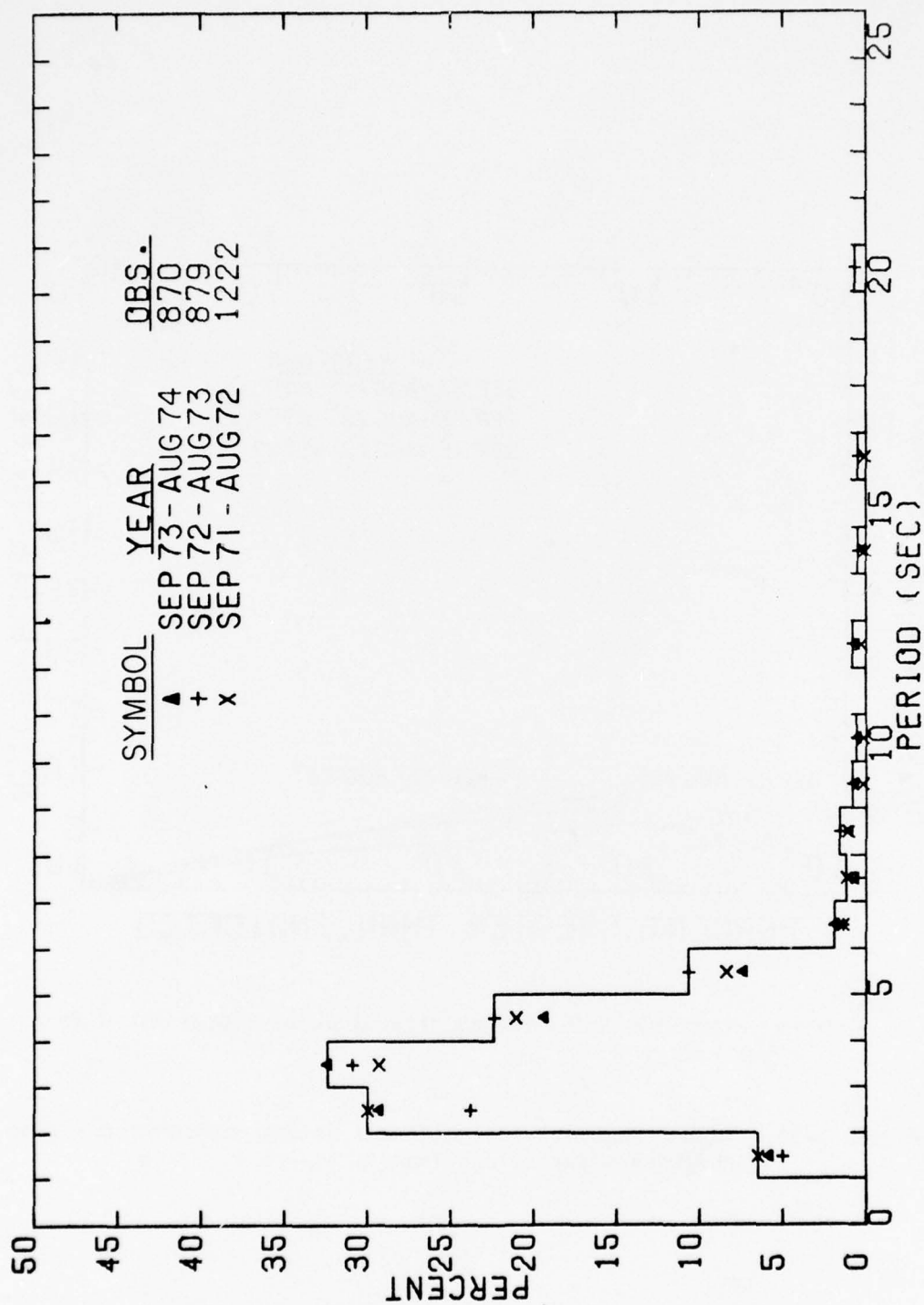


Figure A-21. Annual significant period distributions from Chesapeake Bay Bridge-Tunnel, Virginia; computed from 1,024-second digital wave records taken four times daily.

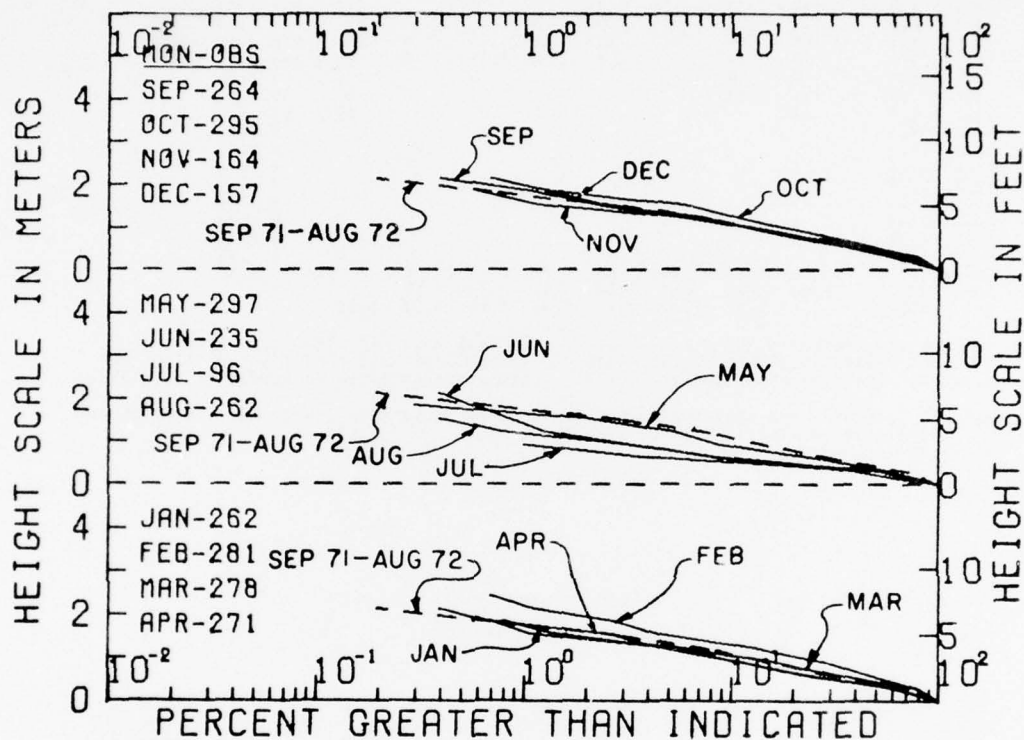


Figure A-22. Seasonal summaries of cumulative significant height distributions from Chesapeake Bay Bridge-Tunnel, Virginia; computed from 1,024-second digital wave records taken four times daily.

Table A-11. Wave climate for Chesapeake Bay-Bridge Tunnel, Virginia.
Distribution of significant height versus period
(in observations per 1,000 observations).

262 OBSERVATIONS										SUMMARY FOR JAN 72 JAN 73 JAN 74			
PERIOD (SECS)	SIG. HEIGHT (FT)												
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*			
0.0 = .9									1000	0.00			
1.0 = 1.9	42	19						61	1000	.61			
2.0 = 2.9	130	137	15	4				286	939	1.13			
3.0 = 3.9	88	115	73	15	8			298	653	1.63			
4.0 = 4.9	65	65	42	23	31	4	4	233	355	2.14			
5.0 = 5.9	38	11		8	4	4		69	122	1.83			
6.0 = 6.9	4	4						8	53	1.00			
7.0 = 7.9	11	11						23	46	1.00			
8.0 = 8.9	15							15	23	.50			
9.0 = 9.9									8	0.00			
10.0 = 10.9									8	0.00			
11.0 = 11.9									8	0.00			
12.0 = 12.9									8	0.00			
13.0 = 13.9									8	0.00			
14.0 = 14.9	4							4	8	.50			
15.0 = 15.9									4	0.00			
16.0 = 16.9	4							4	4	.50			
TOTAL	401	363	130	50	42	8	8			1.52			
CUM. TOTAL	1000	599	237	107	57	15	8						
COL. AVG.	3.88*	3.42	3.71	4.19	4.41	5.00	5.00	3.74					
AVERAGE SIG. HEIGHT = 1.54 FT												AVERAGE WAVE PERIOD = 3.93 SEC*	
VARIANCE OF SIG. HEIGHT = 1.22 FT SQ												VARIANCE OF WAVE PERIOD = 2.77 SEC SQ*	
STANDARD DEVIATION OF HEIGHT = 1.10 FT												STANDARD DEVIATION OF PERIOD = 1.66 SEC*	
RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY													
WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.													
* CALMS ARE OMITTED.													

281 OBSERVATIONS										SUMMARY FOR FEB 72 FEB 73 FEB 74			
PERIOD (SECS)	SIG. HEIGHT (FT)												
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW AVG.*	
0.0 = .9											1000	0.00	
1.0 = 1.9	28	7								36	1000	.70	
2.0 = 2.9	64	103	28							196	964	1.32	
3.0 = 3.9	64	93	78	64	7					306	769	2.03	
4.0 = 4.9	36	75	43	60	71	4	4			292	463	2.78	
5.0 = 5.9	7	7	14	21	11	14	11	4	4	93	171	4.08	
6.0 = 6.9		4	4				4		4	14	78	4.75	
7.0 = 7.9											64	0.00	
8.0 = 8.9	4	14								18	64	1.30	
9.0 = 9.9		7	7							14	46	2.00	
10.0 = 10.9	7									7	32	.50	
11.0 = 11.9											25	0.00	
12.0 = 12.9	7	7	7							21	25	1.50	
13.0 = 13.9											4	0.00	
14.0 = 14.9			4							4	4	2.50	
TOTAL	217	317	185	146	89	18	18	4	7			2.26	
CUM. TOTAL	1000	783	466	281	135	46	28	11	7				
COL. AVG.	3.78*	4.01	4.58	4.21	4.54	5.30	5.50	5.50	6.00	4.21			
AVERAGE SIG. HEIGHT = 2.26 FT													AVERAGE WAVE PERIOD = 4.17 SEC*
VARIANCE OF SIG. HEIGHT = 2.35 FT SQ													VARIANCE OF WAVE PERIOD = 4.05 SEC SQ*
STANDARD DEVIATION OF HEIGHT = 1.53 FT													STANDARD DEVIATION OF PERIOD = 2.01 SEC*

278 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 73 MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	HOW AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9	36	14						50	1000	.79
2.0 = 2.9	72	165	29					266	950	1.34
3.0 = 3.9	36	137	97	58	18			345	683	2.17
4.0 = 4.9	47	58	36	43	18			201	338	2.14
5.0 = 5.9	22	36			11	4	7	79	137	2.27
6.0 = 6.9	4		7					11	58	1.83
7.0 = 7.9		7						7	47	1.50
8.0 = 8.9		4						4	40	1.50
9.0 = 9.9	11	4						14	36	.75
10.0 = 10.9									22	0.00
11.0 = 11.9									22	0.00
12.0 = 12.9	7	7						14	22	1.00
13.0 = 13.9									7	0.00
14.0 = 14.9	4				4			7	7	2.50
TOTAL	237	432	169	101	50	4	7			1.83
CUM. TOTAL	1000	763	331	162	61	11	7			
COL. AVG.	4.03*	3.66	3.67	3.93	5.07	5.50	5.50	3.87		

AVERAGE SIG. HEIGHT = 1.79 FT

AVERAGE WAVE PERIOD = 3.84 SEC*

VARIANCE OF SIG. HEIGHT = 1.27 FT SQ

VARIANCE OF WAVE PERIOD = 3.57 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.13 FT

STANDARD DEVIATION OF PERIOD = 1.89 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

271 OBSERVATIONS

SUMMARY FOR APR 71 APR 72 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	HOW AVG.*
0.0 = .9	15									1000	0.00
1.0 = 1.9	22	7							30	1000	.75
2.0 = 2.9	103	196	22						326	970	1.25
3.0 = 3.9	122	133	66	22	4				352	644	1.50
4.0 = 4.9	44	55	26	26	18	15			187	292	2.30
5.0 = 5.9	41	15		15		4	4	4	82	105	2.05
6.0 = 6.9	4								4	22	.50
7.0 = 7.9	4								4	19	.50
8.0 = 8.9	7								7	15	.50
9.0 = 9.9										7	0.00
10.0 = 10.9										7	0.00
11.0 = 11.9										7	0.00
12.0 = 12.9	7								7	7	.50
TOTAL	369	406	114	63	22	18	4	4			1.53
CUM. TOTAL	1000	631	225	111	48	26	7	4			
COL. AVG.	3.80*	3.19	3.53	4.38	4.33	4.70	5.50	5.50	3.60		

AVERAGE SIG. HEIGHT = 1.56 FT

AVERAGE WAVE PERIOD = 3.59 SEC*

VARIANCE OF SIG. HEIGHT = 1.26 FT SQ

VARIANCE OF WAVE PERIOD = 1.86 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.12 FT

STANDARD DEVIATION OF PERIOD = 1.36 SEC*

297 OBSERVATIONS

SUMMARY FOR MAY 71 MAY 72 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9	44	17						61	1000	.78
2.0 = 2.9	165	145	37					347	939	1.13
3.0 = 3.9	111	104	94	27	17			354	593	1.75
4.0 = 4.9	61	20	34	10	17	10		152	239	2.06
5.0 = 5.9	27	17	7			7	3	61	88	1.89
6.0 = 6.9									27	0.00
7.0 = 7.9		3						3	27	1.50
8.0 = 8.9	7	10						17	24	1.10
9.0 = 9.9		3						3	7	1.50
10.0 = 10.9		3						3	3	1.50
TOTAL	414	323	172	37	34	17	3			1.52
CUM. TOTAL	1000	586	263	91	54	20	3			
COL. AVG.	3.25*	3.45	3.56	3.77	4.00	4.90	5.50	3.45		

AVERAGE SIG. HEIGHT = 1.54 FT

AVERAGE WAVE PERIOD = 3.43 SEC*

VARIANCE OF SIG. HEIGHT = 1.16 FT SQ

VARIANCE OF WAVE PERIOD = 1.75 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.08 FT

STANDARD DEVIATION OF PERIOD = 1.32 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

318 OBSERVATIONS

SUMMARY FOR JUN 71 JUN 72 JUN 73 JUN 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9										1000	0.00
1.0 = 1.9	79	19							97	1000	.69
2.0 = 2.9	182	182	9						374	903	1.04
3.0 = 3.9	85	123	28	6	3				245	528	1.36
4.0 = 4.9	75	60	19	9	3				170	283	1.44
5.0 = 5.9	50	25	3						79	113	.90
6.0 = 6.9	13								13	35	.50
7.0 = 7.9	6								6	22	.50
8.0 = 8.9	13								13	16	.50
9.0 = 9.9	3								3	3	.50
TOTAL	506	409	60	16	6			3			1.12
CUM. TOTAL	1000	494	85	25	9	3	3	3			
COL. AVG.	3.46*	3.23	3.76	4.10	4.00	0.00	0.00	4.50	3.40		

AVERAGE SIG. HEIGHT = 1.15 FT

AVERAGE WAVE PERIOD = 3.40 SEC*

VARIANCE OF SIG. HEIGHT = .49 FT SQ

VARIANCE OF WAVE PERIOD = 1.77 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .70 FT

STANDARD DEVIATION OF PERIOD = 1.33 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

176 OBSERVATIONS

SUMMARY FOR JUL 71 JUL 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9						1000	0.00
1.0 - 1.9	125	23			148	1000	.65
2.0 - 2.9	108	267	17		392	852	1.27
3.0 - 3.9	91	68	51	17	227	460	1.48
4.0 - 4.9	40	68	6		114	233	1.20
5.0 - 5.9	45	40			85	119	.97
6.0 - 6.9	6	6			11	34	1.00
7.0 - 7.9	6	11			17	23	1.17
8.0 - 8.9	6				6	6	.50
TOTAL	426	483	74	17			1.18
CUM. TOTAL	1000	574	91	17			
COL. AVG.	3.13*	3.29	3.35	3.50	3.23		

AVERAGE SIG. HEIGHT = 1.19 FT

AVERAGE WAVE PERIOD = 3.21 SEC*

VARIANCE OF SIG. HEIGHT = .33 FT SQ

VARIANCE OF WAVE PERIOD = 1.79 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .57 FT

STANDARD DEVIATION OF PERIOD = 1.34 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

369 OBSERVATIONS

SUMMARY FOR AUG 71 AUG 72 AUG 73 AUG 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9	65	19					84	1000	.73
2.0 - 2.9	157	125	8				290	916	.99
3.0 - 3.9	114	92	41	27	5		279	626	1.49
4.0 - 4.9	87	46	19	16			168	347	1.29
5.0 - 5.9	70	24			3	3	100	179	.99
6.0 - 6.9	14	5					19	79	.79
7.0 - 7.9	11	3					14	60	.70
8.0 - 8.9	14	5					19	46	.79
9.0 - 9.9	5	5					11	27	1.00
10.0 - 10.9	8	3					11	16	.75
11.0 - 11.9								5	0.00
12.0 - 12.9	3						3	5	.50
13.0 - 13.9								3	0.00
14.0 - 14.9								3	0.00
15.0 - 15.9								3	0.00
16.0 - 16.9								3	0.00
17.0 - 17.9								3	0.00
18.0 - 18.9								3	0.00
19.0 - 19.9								3	0.00
20.0 - 20.9	3						3	3	.50
21.0 *									0.00
TOTAL	550	328	68	43	8	3			1.14
CUM. TOTAL	1000	450	122	54	11	3			
COL. AVG.	3.96*	3.62	3.66	3.88	4.17	5.50	3.83		

AVERAGE SIG. HEIGHT = 1.19 FT

AVERAGE WAVE PERIOD = 3.79 SEC*

VARIANCE OF SIG. HEIGHT = .64 FT SQ

VARIANCE OF WAVE PERIOD = 3.84 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .80 FT

STANDARD DEVIATION OF PERIOD = 1.96 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

264 OBSERVATIONS

SUMMARY FOR SEP 71 SEP 72 SEP 73

PERIOD (SECS)	SIG. HEIGHT (FT)								CUM. MON.	AVG.
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.	TOT.
0.0 = .9									45	1000 0.00
1.0 = 1.9	30	15							45	1000 .83
2.0 = 2.9	91	110	45						246	955 1.32
3.0 = 3.9	53	98	91	45	4				292	708 1.98
4.0 = 4.9	42	64	49	42	27	8	4		239	417 2.52
5.0 = 5.9	23	42	4	4	11	4	4		91	178 2.13
6.0 = 6.9	19	19							38	87 1.00
7.0 = 7.9		4							4	49 1.50
8.0 = 8.9	8								8	45 .50
9.0 = 9.9	4		4	4					11	38 2.17
10.0 = 10.9		8							8	27 1.50
11.0 = 11.9										19 0.00
12.0 = 12.9	8	4	4						15	19 1.25
13.0 = 13.9										4 0.00
14.0 = 14.9	4								4	4 .50
TOTAL	280	364	197	95	42	11	8	4		1.84
CUM. TOTAL	1000	720	356	159	64	23	11	4		
COL. AVG.	4.08	3.96	3.85	4.26	4.68	4.83	5.00	4.50	4.05	

AVERAGE SIG. HEIGHT = 1.82 FT AVERAGE WAVE PERIOD = 4.01 SEC
 VARIANCE OF SIG. HEIGHT = 1.42 FT SQ VARIANCE OF WAVE PERIOD = 3.76 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.19 FT STANDARD DEVIATION OF PERIOD = 1.94 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.
 * CALMS ARE OMITTED.

295 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 72 OCT 73

PERIOD (SECS)	SIG. HEIGHT (FT)								CUM. MON.	AVG.
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.	TOT.
0.0 = .9									41	1000 0.00
1.0 = 1.9	24	17							41	1000 .92
2.0 = 2.9	64	156	37		3				261	959 1.44
3.0 = 3.9	41	81	108	51	14				295	698 2.21
4.0 = 4.9	31	58	24	61	24	20	7		224	403 2.85
5.0 = 5.9	34	37	7	3	7	27		7	122	180 2.72
6.0 = 6.9	3	7	14						24	58 1.93
7.0 = 7.9	3	3	3						10	34 1.50
8.0 = 8.9	17	7							24	24 .79
TOTAL	217	366	193	115	47	47	7	7		2.11
CUM. TOTAL	1000	783	417	224	108	61	14	7		
COL. AVG.	3.94	3.53	3.78	4.09	4.21	5.07	4.50	5.50	3.86	

AVERAGE SIG. HEIGHT = 2.10 FT AVERAGE WAVE PERIOD = 3.83 SEC
 VARIANCE OF SIG. HEIGHT = 1.93 FT SQ VARIANCE OF WAVE PERIOD = 1.87 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.39 FT STANDARD DEVIATION OF PERIOD = 1.37 SEC

163 OBSERVATIONS

SUMMARY FOR NOV 72 NOV 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. ROW TOT.*	AVG.*
0.0 - .9	18							1000	0.00
1.0 - 1.9	61						63	1000	.50
2.0 - 2.9	129	104					238	938	.95
3.0 - 3.9	55	117	123	31	12		344	700	1.99
4.0 - 4.9	43	55	61	49	31		244	356	2.37
5.0 - 5.9	43	18		12	6	6	88	113	1.79
6.0 - 6.9		12					13	25	1.50
7.0 - 7.9		6					6	13	1.50
8.0 - 8.9								6	0.00
9.0 - 9.9								6	0.00
10.0 - 10.9								6	0.00
11.0 - 11.9								6	0.00
12.0 - 12.9								6	0.00
13.0 - 13.9								6	0.00
14.0 - 14.9				6			6	6	3.50
TOTAL	350	313	184	98	49	6			1.70
CUM. TOTAL	1000	650	337	193	55	6			
COL. AVG.	3.13*	3.66	3.83	4.94	4.38	5.50	3.69		

AVERAGE SIG. HEIGHT = 1.72 FT

AVERAGE WAVE PERIOD = 3.64 SEC*

VARIANCE OF SIG. HEIGHT = 1.20 FT SQ

VARIANCE OF WAVE PERIOD = 1.90 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.10 FT

STANDARD DEVIATION OF PERIOD = 1.38 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.

* CALMS ARE OMITTED.

157 OBSERVATIONS

SUMMARY FOR DEC 71 DEC 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. ROW TOT.*	AVG.*
0.0 - .9	6								1000	0.00
1.0 - 1.9	32	6						38	1000	.67
2.0 - 2.9	127	159	57					346	962	1.30
3.0 - 3.9	121	64	64	32	6		6	285	615	1.70
4.0 - 4.9	57	32	38	25	38		6	199	321	2.40
5.0 - 5.9	25	25	6	6	6	13		83	122	2.27
6.0 - 6.9	13							13	38	.50
7.0 - 7.9									26	0.00
8.0 - 8.9	13	6						19	26	.83
9.0 - 9.9									6	0.00
10.0 - 10.9	6							6	6	.50
TOTAL	401	293	166	64	51	13	13			1.66
CUM. TOTAL	1000	599	306	140	76	25	13			
COL. AVG.	3.66*	3.30	3.46	4.10	4.50	5.50	4.00	3.62		

AVERAGE SIG. HEIGHT = 1.69 FT

AVERAGE WAVE PERIOD = 3.92 SEC*

VARIANCE OF SIG. HEIGHT = 1.59 FT SQ

VARIANCE OF WAVE PERIOD = 1.63 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.26 FT

STANDARD DEVIATION OF PERIOD = 1.35 SEC*

3131 OBSERVATIONS

SUMMARY FOR 35 MONTHS APR 71 THROUGH AUG 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9	3										1000	0.00
1.0 - 1.9	48	14								62	1000	.73
2.0 - 2.9	118	152	25							296	938	1.19
3.0 - 3.9	82	104	74	33	8					303	642	1.78
4.0 - 4.9	54	55	32	30	22	5	2	1		201	340	2.20
5.0 - 5.9	36	25	4	5	5	7	3	1		86	138	2.02
6.0 - 6.9	7	4	2							14	52	1.45
7.0 - 7.9	4	4								8	38	1.06
8.0 - 8.9	9	4								13	30	.82
9.0 - 9.9	2	2	1							5	17	1.38
10.0 - 10.9	2	1								3	11	.90
11.0 - 11.9											8	0.00
12.0 - 12.9	3	2	1							5	8	1.15
13.0 - 13.9											3	0.00
14.0 - 14.9	1									2	3	2.00
15.0 - 15.9											1	0.00
16.0 - 16.9											1	.50
TOTAL	368	366	140	70	36	12	5	2	1			1.61
CUM. TOTAL	1000	632	266	126	56	20	8	3	1			
COL. AVG.	3.68*	3.52	3.79	4.18	4.47	5.06	5.09	5.17	6.00	3.73		

AVERAGE SIG. HEIGHT = 1.62 FT AVERAGE WAVE PERIOD = 3.70 SEC*
 VARIANCE OF SIG. HEIGHT = 1.35 FT SQ VARIANCE OF WAVE PERIOD = 2.72 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.16 FT STANDARD DEVIATION OF PERIOD = 1.65 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT THIMBLE SHOALS CHANNEL.
 * CALMS ARE OMITTED.

Table A-12. CERC wave gage history for 15th Street Fishing Pier, Virginia Beach, Virginia.

CERC Form 174-74

18 Mar 74

COORDINATES: 36°51' N., 75°58' W.

LOCATION: 15th Street Fishing Pier, Virginia Beach, Virginia

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance (SR), staff-parallel type	13 Oct. 1962	26 Nov. 1962	Gage and part of pier destroyed by storm.	25		18	60 ft (on north side of pier)	800
SR staff-relay type	2 Mar. 1963	17 Jan. 1965	Gage and part of pier destroyed by storm.	25		18	60 ft (on north side of pier)	800
SR staff-relay type	29 Nov. 1965	20 Sept. 1966	Gage temporarily removed during pier repair.	25		20	12 ft (on north side of pier)	900
SR staff-relay type	3 Nov. 1966	31 Mar. 1970	Recorder house vandalized.	25		20	12 ft (on north side of pier)	900
	22 Apr. 1970	26 Mar. 1971	Gage destroyed by storm; not replaced.					

Table A-13. Number of analyzed records from Virginia Beach, Virginia.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1962										71	50		121
1963			43	52	16	131	26	72	104	137	159	178	918
1964	186	163	182	174	30	83	143	102	51	152	179	158	1603
1965	85										3	119	207
1966	177	155	148	170	166	180	125	174	101		167	186	1749
1967	173	150	88	100	105	180	183	172	180	148	180	143	1802
1968	186	163	175	128	145	80						118	995
1969	111	107	101	85	84	56	121	121	104	59			949

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the second BEB method for 1962 to March 1964 and analyzed by the CERC method for April 1964 to June 1968. Results after November 1968 obtained from 1,024-second digital records taken four times daily.

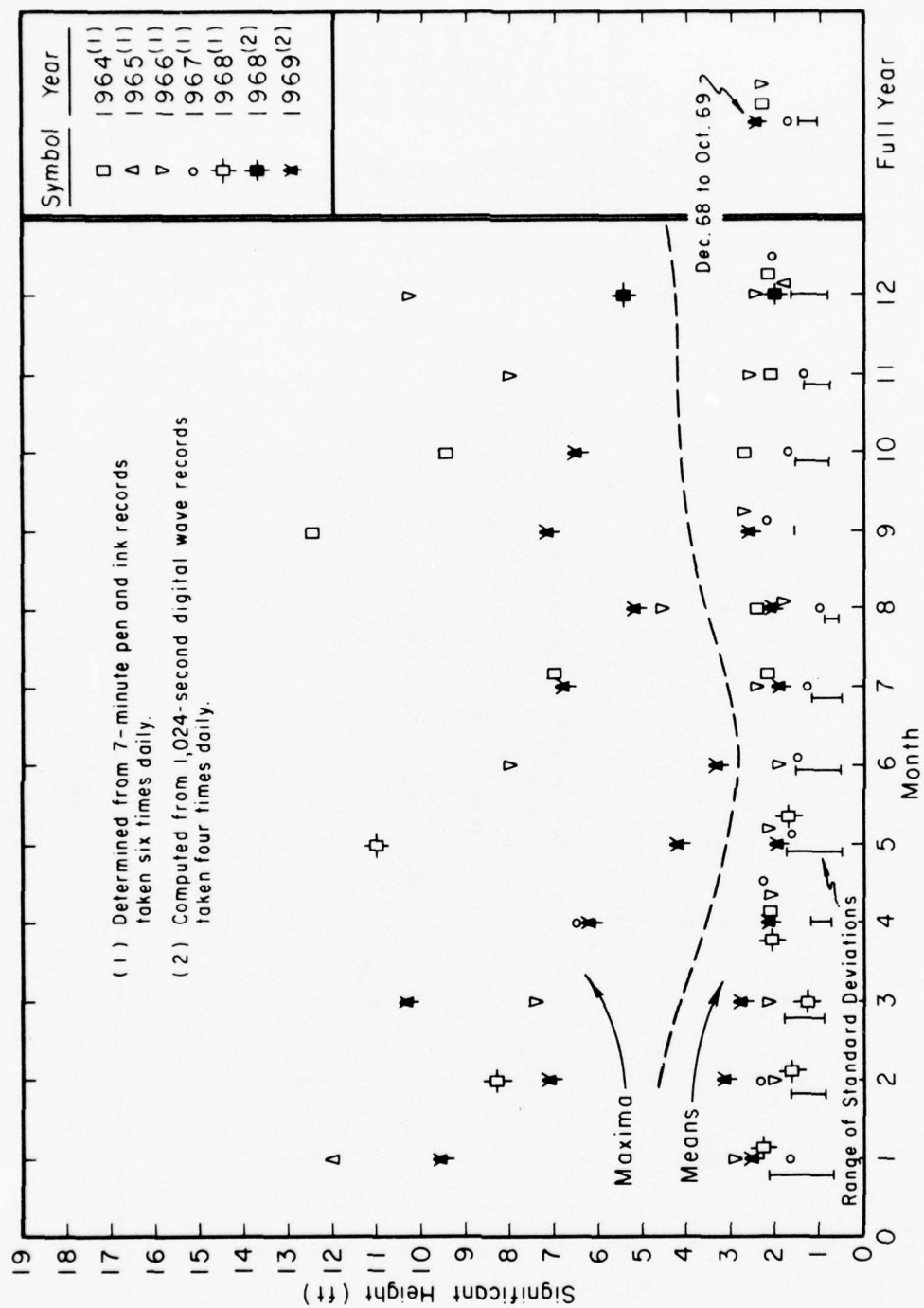


Figure A-23. Maxima, means, and standard deviations of significant height from Virginia Beach, Virginia.

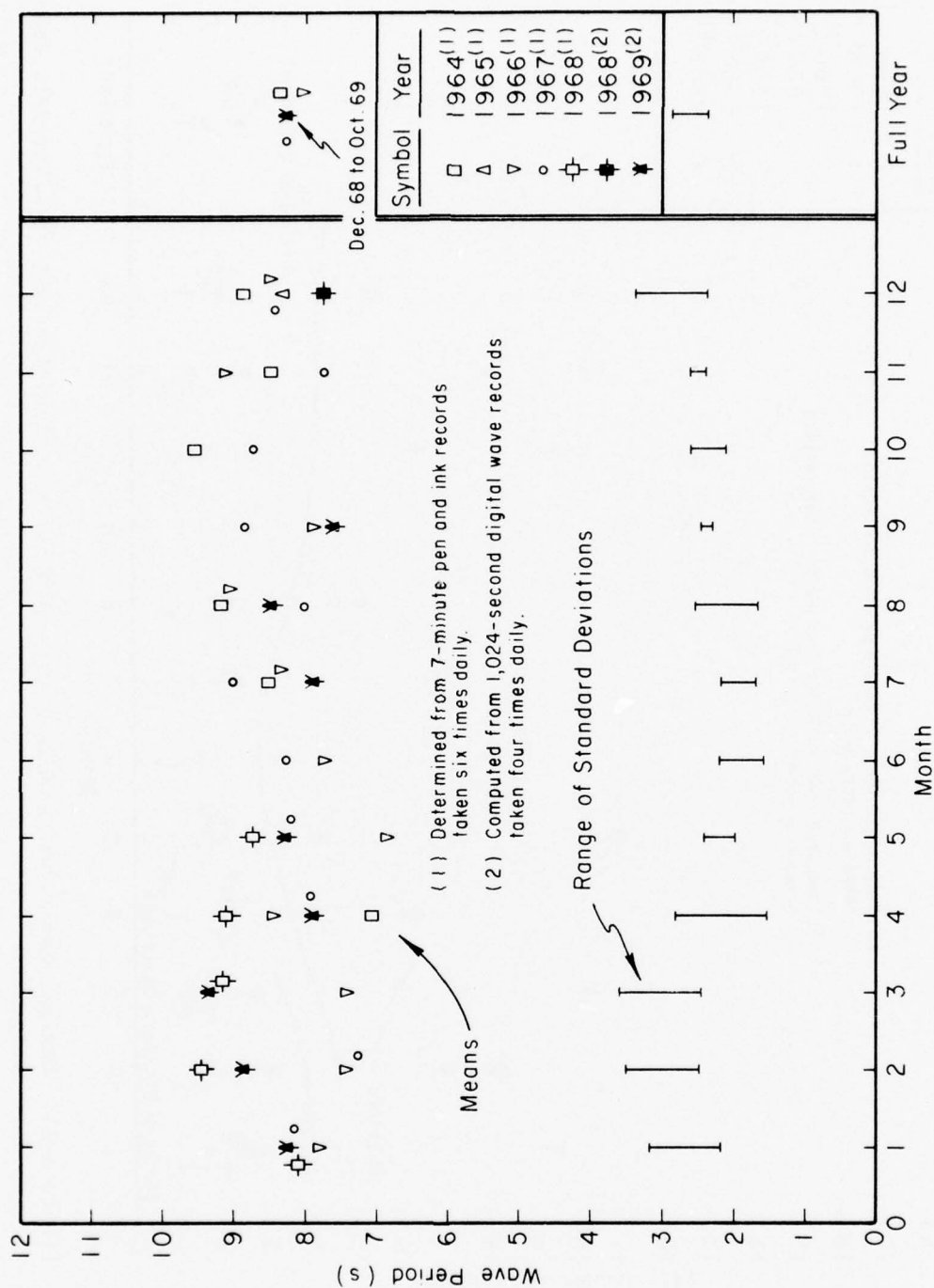
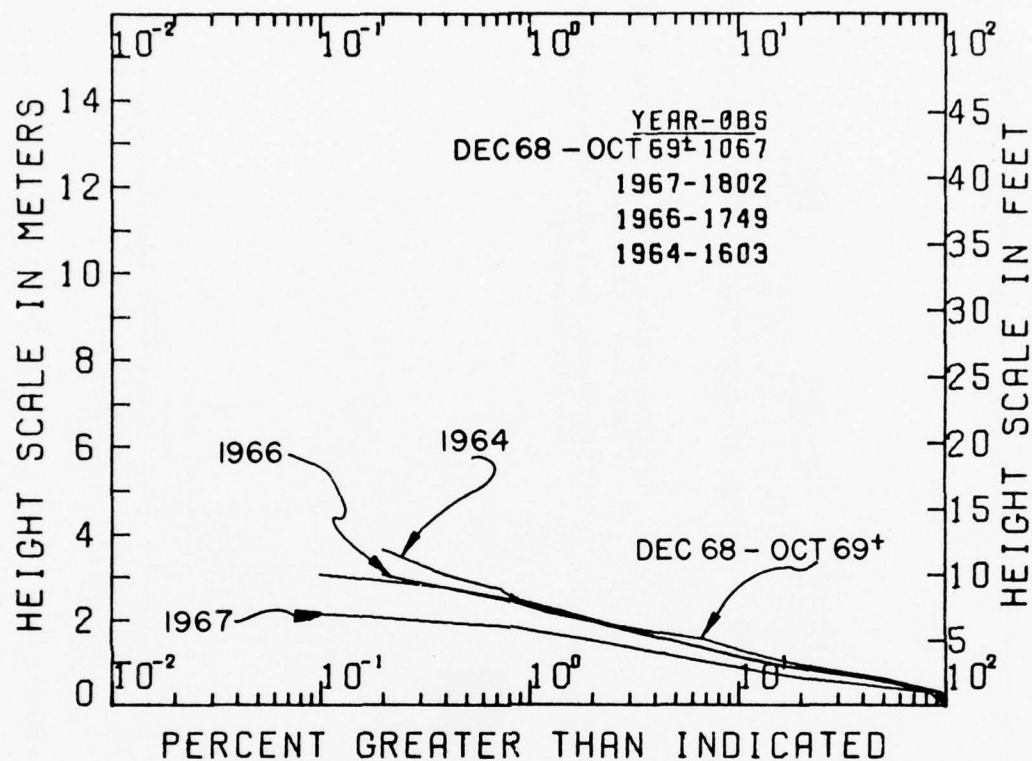


Figure A-24. Means and standard deviations of wave periods for Virginia Beach, Virginia.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-25. Annual cumulative significant height distributions from Virginia Beach, Virginia.

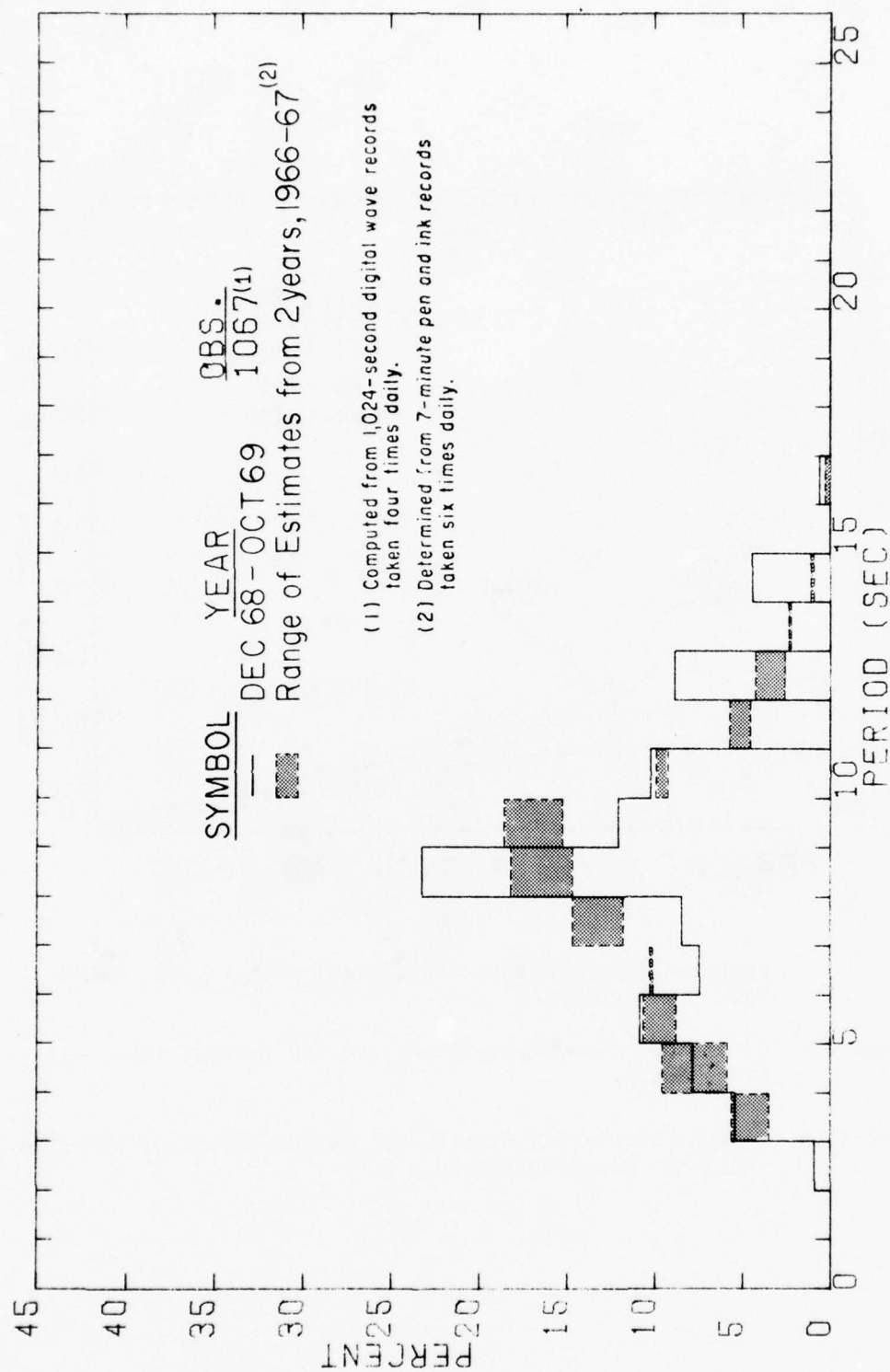


Figure A-26. Annual significant period distributions from Virginia Beach, Virginia.

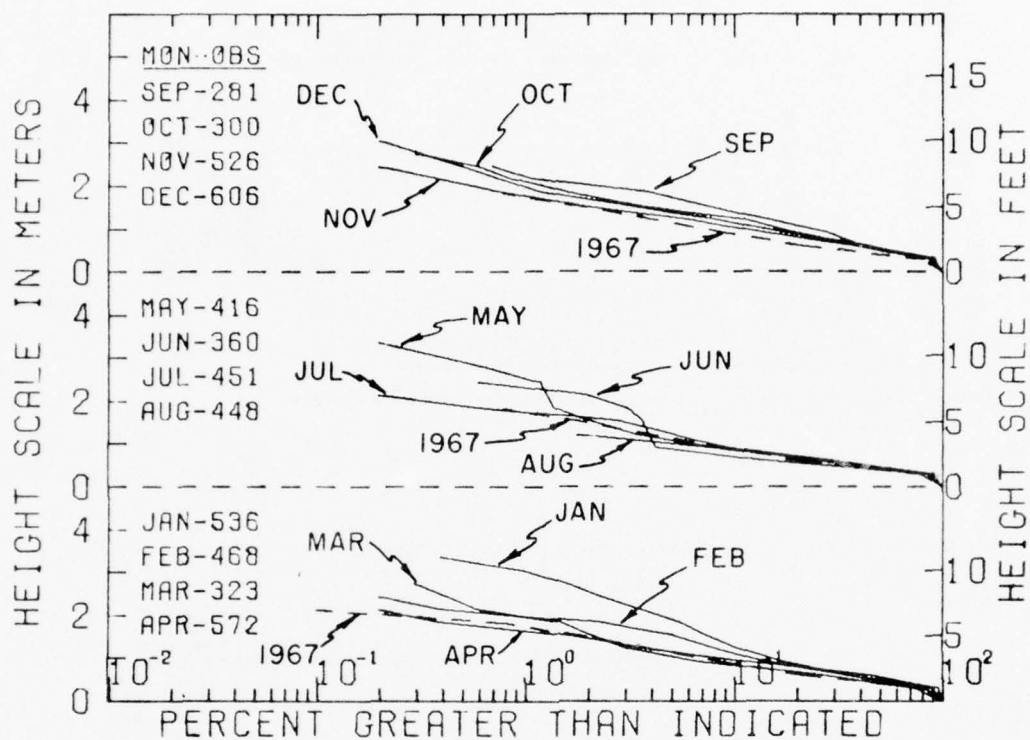


Figure A-27. Seasonal summaries of cumulative significant height distributions from Virginia Beach, Virginia; determined from 7-minute pen and ink records taken six times daily.

Table A-14. Wave Climate for Virginia Beach, Virginia.
Distribution of significant height versus period
(in observations per 1,000 observations).

BEST AVAILABLE COPY

536 OBSERVATIONS													SUMMARY FOR JAN 66 JAN 67 JAN 68		
PERIOD (SECS)	HEIGHT (FT)														
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT.	CUM.	RD=
1.0 = 1.9	2												2	1000	.00
2.0 = 2.9														1000	.00
3.0 = 3.9														1000	.00
4.0 = 4.9														17	1000
5.0 = 5.9														30	1000
6.0 = 6.9														99	1000
7.0 = 7.9														142	1000
8.0 = 8.9														116	1000
9.0 = 9.9														108	1000
10.0 = 10.9														110	1000
11.0 = 11.9														146	1000
12.0 = 12.9														69	1000
13.0 = 13.9														47	1000
14.0 = 14.9														36	1000
TOTAL	108	535	170	69	35	19	19	13	7	6	6	6	6	13	1000
CUM. TOTAL	1000	892	356	177	108	71	54	35	22	15	9	4	4		
COL. AVG.	8.94	8.19	6.90	7.96	7.87	8.00	8.80	8.50	9.00	9.17	9.83	10.50	8.02		
AVERAGE SIG. HEIGHT = 2.25 FT AVERAGE WAVE PERIOD = 8.02 SEC VARIANCE OF SIG. HEIGHT = 3.11 FT SQ VARIANCE OF WAVE PERIOD = 7.34 SEC SQ STANDARD DEVIATION OF HEIGHT = 1.76 FT STANDARD DEVIATION OF PERIOD = 2.72 SEC															
RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEEP RESISTANCE RELAY WAVE GAGE LOCATED AT 15TH STREET PIER * CALMS ARE OMITTED.															

468 OBSERVATIONS													SUMMARY FOR FEB 66 FEB 67 FEB 68		
PERIOD (SECS)	HEIGHT (FT)														
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT.	CUM.	RD=
1.0 = 1.9	83												83	1000	.00
2.0 = 2.9														1000	.00
3.0 = 3.9														1000	.00
4.0 = 4.9														26	1000
5.0 = 5.9														47	1000
6.0 = 6.9														121	1000
7.0 = 7.9														121	1000
8.0 = 8.9														119	1000
9.0 = 9.9														91	1000
10.0 = 10.9														77	1000
11.0 = 11.9														126	1000
12.0 = 12.9														100	1000
13.0 = 13.9														86	1000
14.0 = 14.9														40	1000
15.0 = 15.9														26	1000
TOTAL	192	459	199	64	34	28	19	2	2	2	2	2	2	14	1000
CUM. TOTAL	1000	808	348	150	85	51	24	4	2	2	2	2	2		
COL. AVG.	7.94	8.09	7.65	7.33	7.62	8.50	8.83	10.50	15.50	7.96					
AVERAGE SIG. HEIGHT = 1.97 FT AVERAGE WAVE PERIOD = 7.96 SEC VARIANCE OF SIG. HEIGHT = 1.84 FT SQ VARIANCE OF WAVE PERIOD = 8.33 SEC SQ STANDARD DEVIATION OF HEIGHT = 1.36 FT STANDARD DEVIATION OF PERIOD = 2.89 SEC															

322 OBSERVATIONS

SUMMARY FOR MAR 56

MAR 56

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.*	CUM. TOT.*	RDV. AVG.*
1.0 - 1.9	115								4	1000	1.00
2.0 - 2.9	3									1000	1.50
2.5 - 2.9										996	1.00
3.0 - 3.9	6	6							14	996	1.00
3.5 - 3.9	9	19	16						49	982	1.04
4.0 - 4.9		37	37	3					88	933	2.06
5.0 - 5.9	9	28	40	3					91	846	1.96
6.0 - 6.9	19	34	16	3	3		3		66	754	1.88
7.0 - 7.9	6	47	16	6			3	3	91	667	2.19
8.0 - 8.9	16	50	16	9	6	3	5		116	575	2.14
9.0 - 9.9	37	99	22	3	3				186	480	1.50
10.0 - 10.9	19	78	19	3					133	274	1.55
11.0 - 11.9	6	47	16	3		3			84	140	1.88
12.0 - 12.9	9	16		3					32	56	1.39
13.0 - 13.9	6	3							11	25	1.63
14.0 - 14.9		3							4	14	1.50
15.0 - 15.9	3	6							11	11	1.17
TOTAL	264	472	196	37	12	6	9	3			1.63
CUM. TOTAL	1000	736	264	68	31	19	12	3			
COL. AVG.	8.00	8.64	7.04	8.42	8.25	10.00	7.50	7.50	8.26		

AVERAGE SIG. HEIGHT = 1.63 FT

AVERAGE WAVE PERIOD = 8.26 SEC

VARIANCE OF SIG. HEIGHT = 1.15 FT SQ

VARIANCE OF WAVE PERIOD = 7.13 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.07 FT

STANDARD DEVIATION OF PERIOD = 2.67 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT 15TH STREET PIER

* CALMS ARE OMITTED.

571 OBSERVATIONS

SUMMARY FOR APR 64 APR 66 APR 67 APR 68

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	RDV. AVG.*
1.0 - 1.9	4								1000	1.00
2.0 - 2.4									1000	1.00
2.5 - 2.9									1000	1.00
3.0 - 3.4	2	18	2					21	1000	1.50
3.5 - 3.9	2	16	4					21	979	1.58
4.0 - 4.9	2	25	21	5	5			58	958	2.29
5.0 - 5.9		33	72	14	2	2		123	900	2.41
6.0 - 6.9	4	67	37	18	2	5		132	777	2.22
7.0 - 7.9		63	37	11	11			121	645	2.24
8.0 - 8.9	16	93	63	9	2			183	524	1.88
9.0 - 9.9	11	74	28	9	4			125	341	1.87
10.0 - 10.9	2	58	37	2				98	216	1.89
11.0 - 11.9	2	28	14	11			2	56	118	2.25
12.0 - 12.9	2	21	12	2		2		34	62	2.05
13.0 - 13.9		9	5			2		16	23	2.28
14.0 - 14.9			4	2		2		7	7	3.50
TOTAL	44	503	335	61	25	12	2			2.08
CUM. TOTAL	1000	956	454	119	39	14	2			
COL. AVG.	8.37*	8.18	7.91	7.91	7.00	9.36	11.50	8.07		

AVERAGE SIG. HEIGHT = 2.08 FT

AVERAGE WAVE PERIOD = 8.07 SEC

VARIANCE OF SIG. HEIGHT = .82 FT SQ

VARIANCE OF WAVE PERIOD = 5.85 SEC SQ

STANDARD DEVIATION OF HEIGHT = .91 FT

STANDARD DEVIATION OF PERIOD = 2.42 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT 15TH STREET PIER

* CALMS ARE OMITTED.

416 OBSERVATIONS

SUMMARY FOR MAY 66 MAY 67 MAY 68

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	TOT.*	CUM. TOT.*	RD=
1.0 = 1.9	46													1000	.00
2.0 = 2.4														1000	.00
2.5 = 2.9		2												3	1000 1.50
3.0 = 3.4		7												8	997 1.50
3.5 = 3.9	2	38	7											50	990 1.60
4.0 = 4.9	2	48	29	5	2	2								93	940 2.09
5.0 = 5.9	2	31	36	12		2								91	846 2.31
6.0 = 6.9	2	70	10	10	7	2			2					108	756 2.22
7.0 = 7.9	19	89	41	5										161	647 1.70
8.0 = 8.9	14	111	31	2			2							169	486 1.71
9.0 = 9.9	17	91	26	2	2				2				2	151	317 1.93
10.0 = 10.9	14	46	24	12	2					5				108	166 2.27
11.0 = 11.9	10	10	5	2										28	58 1.50
12.0 = 12.9	2	7	2											13	30 1.50
13.0 = 13.9		7												8	18 1.50
14.0 = 14.9	2													3	10 .50
15.0 = 15.9	5													5	8 .50
16.0 = 16.9	2													3	3 .50
TOTAL	142	558	214	50	14	7	2		5	5		2	2		1.65
CUM. TOTAL	1000	858	300	87	36	22	14	12	12	7	2	2			
COL. AVG.	9.53*	7.65	7.44	7.60	7.33	5.50	8.50	.00	8.00	10.50	.00	9.50	7.79		

AVERAGE SIG. HEIGHT = 1.85 FT

AVERAGE WAVE PERIOD = 7.79 SEC*

VARIANCE OF SIG. HEIGHT = 1.52 FT SQ

VARIANCE OF WAVE PERIOD = 5.55 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.23 FT

STANDARD DEVIATION OF PERIOD = 2.36 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT 15TH STREET PIER

* CALMS ARE OMITTED.

360 OBSERVATIONS

SUMMARY FOR JUN 66 JUN 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	RD=
1.0 = 1.9											1000	.00
2.0 = 2.4											1000	.00
2.5 = 2.9											1000	.00
3.0 = 3.4	8	6								14	1000	.90
3.5 = 3.9		36	3							39	986	1.57
4.0 = 4.9		28	6							33	947	1.67
5.0 = 5.9	6	28	19							53	914	1.76
6.0 = 6.9		64	11			3	6	6	3	92	861	2.62
7.0 = 7.9	25	167	22	6			6	8		233	769	1.87
8.0 = 8.9	19	183	17			3			3	225	536	1.62
9.0 = 9.9	14	214	17							244	311	1.51
10.0 = 10.9	6	28								33	67	1.33
11.0 = 11.9	3	8								11	33	1.25
12.0 = 12.9	3	3								6	22	1.00
13.0 = 13.9		6	3							8	17	1.83
14.0 = 14.9		8								8	8	1.50
TOTAL	83	778	97	6		6	11	14	6			1.72
CUM. TOTAL	1000	917	139	42	36	36	31	19	6			
COL. AVG.	8.01*	8.11	7.39	7.50	.00	7.50	7.00	7.10	7.50	7.99		

AVERAGE SIG. HEIGHT = 1.72 FT

AVERAGE WAVE PERIOD = 7.99 SEC*

VARIANCE OF SIG. HEIGHT = 1.29 FT SQ

VARIANCE OF WAVE PERIOD = 3.69 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.14 FT

STANDARD DEVIATION OF PERIOD = 1.92 SEC*

451 OBSERVATIONS

SUMMARY FOR JUL 64 JUL 66 JUL 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.0										1000	1.00
2.0 = 2.0										1000	1.00
2.5 = 2.0										1000	1.00
3.0 = 3.0										1000	1.00
3.5 = 3.0			4						4	1000	2.50
4.0 = 4.0		7	4						11	990	1.90
4.0 = 4.0		7	9						20	980	2.30
5.0 = 5.0		18	16	4	2				40	965	2.20
6.0 = 6.0	2	22	11	11	9	11			67	925	3.03
7.0 = 7.0	16	73	42	7	2	7	4		151	858	2.13
8.0 = 8.0	40	197	38	7	9	4			295	707	1.69
9.0 = 9.0	33	182	33	4	2			2	257	412	1.61
10.0 = 10.0	11	62	13	2					89	155	1.57
11.0 = 11.0	2	11	4						18	67	1.62
12.0 = 12.0	4	7	2						13	49	1.33
13.0 = 13.0	2	11							13	35	1.33
14.0 = 14.0	2	7	9	2					20	22	2.00
15.0 = 15.0									2	2	1.50
16.0 = 16.0		2							2	2	1.50
TOTAL	113	605	186	42	24	22	4	2			1.85
CUM. TOTAL	1000	887	282	95	53	29	7	2			
COL. AVG.	9.25*	8.91	8.20	7.61	7.50	7.20	7.50	9.50	8.69		

AVERAGE SIG. HEIGHT = 1.85 FT

AVERAGE WAVE PERIOD = 8.69 SEC*

VARIANCE OF SIG. HEIGHT = 1.11 FT SQ

VARIANCE OF WAVE PERIOD = 3.61 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.05 FT

STANDARD DEVIATION OF PERIOD = 1.90 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT 15TH STREET PIER
 * CALMS ARE OMITTED.

448 OBSERVATIONS

SUMMARY FOR AUG 64 AUG 66 AUG 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.0	16						1000	1.00
2.0 = 2.0							1000	1.00
2.5 = 2.0							1000	1.00
3.0 = 3.0			4	2		7	1000	1.83
3.5 = 3.0				4		5	993	2.50
4.0 = 4.0	2	11	9	7		29	989	2.19
5.0 = 5.0	9	22	13	9	2	57	959	2.02
6.0 = 6.0	25	58	13	7		104	902	1.52
7.0 = 7.0	34	83	11	11		161	798	1.37
8.0 = 8.0	67	129	27	4	2	234	637	1.39
9.0 = 9.0	18	107	33			161	404	1.60
10.0 = 10.0	18	42	31	11	2	107	243	1.90
11.0 = 11.0	7	20	22	2	2	54	136	2.00
12.0 = 12.0	4	11	7	2	9	34	82	2.50
13.0 = 13.0	4	11	2	4		23	48	1.80
14.0 = 14.0	2	16	4	2		25	25	1.77
TOTAL	225	516	181	60	18			1.63
CUM. TOTAL	1000	775	259	78	18			
COL. AVG.	8.45*	8.72	8.93	8.43	10.75	8.72		

AVERAGE SIG. HEIGHT = 1.63 FT

AVERAGE WAVE PERIOD = 8.72 SEC*

VARIANCE OF SIG. HEIGHT = .79 FT SQ

VARIANCE OF WAVE PERIOD = 4.89 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .89 FT

STANDARD DEVIATION OF PERIOD = 2.21 SEC*

281 OBSERVATIONS

SUMMARY FOR SEP 66 SEP 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. ROW TOT.*	AVG.*
1.0 = 1.9	11	4								4	1000	1.50
2.0 = 2.4											996	.00
2.5 = 2.9											996	.00
3.0 = 3.4	4	11	7							22	996	1.67
3.5 = 3.9		7	7							14	975	2.00
4.0 = 4.9		28	11	7	4					50	960	2.21
5.0 = 5.9		36	14	25	11	4				90	910	2.74
6.0 = 6.9	4	21	7	21	18	11	7			90	820	3.50
7.0 = 7.9		28	21	18	14	14	4	4		119	730	3.83
8.0 = 8.9	11	96	18	25	11	4		4		169	612	2.27
9.0 = 9.9	25	125	7	14	4	4				183	442	1.79
10.0 = 10.9	18	68	11	4						101	259	1.50
11.0 = 11.9	18	36	14	14	7					90	158	2.02
12.0 = 12.9	4	18		7	4					36	68	2.60
13.0 = 13.9	11	11	11							32	32	1.50
TOTAL	103	488	128	135	71	36	28	4	7			2.36
CUM. TOTAL	1000	897	409	281	146	75	39	11	7			
COL. AVG.	10.18*	8.67	7.97	7.97	7.70	7.30	8.13	7.50	8.00	8.48		

AVERAGE SIG. HEIGHT = 2.36 FT

AVERAGE WAVE PERIOD = 8.51 SEC*

VARIANCE OF SIG. HEIGHT = 2.42 FT SQ

VARIANCE OF WAVE PERIOD = 5.81 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.56 FT

STANDARD DEVIATION OF PERIOD = 2.41 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT 15TH STREET PIER

* CALMS ARE OMITTED.

300 OBSERVATIONS

SUMMARY FOR OCT 64 OCT 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. ROW TOT.*	AVG.*
1.0 = 1.9	3										3	1000	.00
2.0 = 2.4												1000	.00
2.5 = 2.9												1000	.00
3.0 = 3.4		3									3	1000	1.50
3.5 = 3.9												997	.00
4.0 = 4.9		7	7								13	997	2.00
5.0 = 5.9		25	27	10	7						67	983	2.50
6.0 = 6.9		27	37	30	30	10					134	916	3.20
7.0 = 7.9		67	23	10	7	3		3			117	783	2.56
8.0 = 8.9	10	87	43	3	10	3				3	161	666	2.12
9.0 = 9.9	50	100	20	10	7						167	505	1.68
10.0 = 10.9	7	43	20	7	13		3				114	338	2.24
11.0 = 11.9	17	50	13	3	3				3		90	224	1.91
12.0 = 12.9	7	37	17	7		3					70	134	2.02
13.0 = 13.9		13	7	3							23	64	2.07
14.0 = 14.9	3	30	3								37	40	1.50
15.0 = 15.9		3									3	3	1.50
TOTAL	77	510	217	83	77	20	7	3	3	3			2.22
CUM. TOTAL	1000	923	413	197	113	37	17	10	7	3			
COL. AVG.	10.41*	9.60	8.58	8.22	7.93	8.00	9.50	7.50	11.50	7.50	9.15		

AVERAGE SIG. HEIGHT = 2.22 FT

AVERAGE WAVE PERIOD = 9.15 SEC*

VARIANCE OF SIG. HEIGHT = 1.78 FT SQ

VARIANCE OF WAVE PERIOD = 5.77 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.33 FT

STANDARD DEVIATION OF PERIOD = 2.40 SEC*

526 OBSERVATIONS

SUMMARY FOR NOV 64 NOV 66 NOV 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = 1.9	17										1000	.00
2.0 = 2.4											1000	.00
2.5 = 2.9											1000	.00
3.0 = 3.4	4	2								6	1000	.83
3.5 = 3.9	2	8	2							12	994	1.50
4.0 = 4.9	10	36	21	11		2				81	983	2.02
5.0 = 5.9	13	38	30	34	4					122	901	2.31
6.0 = 6.9	11	40	23	11	13	10	2			112	779	2.60
7.0 = 7.9	8	32	32	10	6		4			95	667	2.50
8.0 = 8.9	17	47	27		6				2	118	573	1.73
9.0 = 9.9	32	99	30		2					166	455	1.52
10.0 = 10.9	17	72	30	2	4					128	288	1.73
11.0 = 11.9		55	19	4	4					83	161	1.97
12.0 = 12.9	4	25	13	2						44	77	1.80
13.0 = 13.9		6	2	2	4					16	33	2.79
14.0 = 14.9	2	13	2	2						19	19	1.70
TOTAL	137	492	232	78	42	11	6		2			1.96
CUM. TOTAL	1000	863	371	139	61	19	8	2	2			
COL. AVG.	8.13*	8.90	8.33	6.74	8.41	6.17	7.17	.00	7.50	4.44		

AVERAGE SIG. HEIGHT = 1.96 FT

AVERAGE WAVE PERIOD = 8.44 SEC*

VARIANCE OF SIG. HEIGHT = 1.26 FT SQ

VARIANCE OF WAVE PERIOD = 6.53 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.12 FT

STANDARD DEVIATION OF PERIOD = 2.56 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT 15TH STREET PIER

* CALMS ARE OMITTED.

606 OBSERVATIONS

SUMMARY FOR DEC 64 DEC 65 DEC 66 DEC 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = 1.9	2			2								2	1000	3.50
2.0 = 2.4													998	.00
2.5 = 2.9													998	.00
3.0 = 3.4	2	13										15	998	1.39
3.5 = 3.9	3	21	7									31	983	1.61
4.0 = 4.9	5	18	13	3	8							48	952	2.33
5.0 = 5.9	7	33	28	30	15	5						117	904	2.74
6.0 = 6.9	8	36	28	17	15	7	3					114	787	2.73
7.0 = 7.9	12	26	23	8	3	3			2			78	673	2.31
8.0 = 8.9	10	58	25	8	2	3	2				2	109	595	2.17
9.0 = 9.9	26	101	40	10		2	2		2			182	486	1.83
10.0 = 10.9	18	69	26	7	3							124	304	1.75
11.0 = 11.9	13	46	20	3								83	180	1.66
12.0 = 12.9	2	28	18	3								51	98	1.95
13.0 = 13.9		13	10	3	2							28	46	2.26
14.0 = 14.9	2	2	13									17	18	2.20
15.0 = 15.9												2	2	.00
16.0 = 16.9					2							2	2	4.50
TOTAL	109	465	251	94	50	20	7		3		2			2.13
CUM. TOTAL	1000	891	426	175	81	31	12	5	5	2	2			
COL. AVG.	8.75*	8.77	8.92	7.51	6.83	7.00	7.75	.00	8.50	.00	8.50	8.55		

AVERAGE SIG. HEIGHT = 2.13 FT

AVERAGE WAVE PERIOD = 8.56 SEC*

VARIANCE OF SIG. HEIGHT = 1.56 FT SQ

VARIANCE OF WAVE PERIOD = 7.13 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.25 FT

STANDARD DEVIATION OF PERIOD = 2.67 SEC*

5265 OBSERVATIONS

SUMMARY FOR 34 MONTHS APR 64 THROUGH MAY 68

PERIOD (SECS)	HEIGHT (FT)												CUM. TOT. #	ROW
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	TOT. #	AVG. #
0.0 - 1.0	23												1000	2.50
2.0 - 2.9													1000	1.50
3.0 - 3.9	3	9	1										999	1.34
4.0 - 4.9	3	17	5										26	986
5.0 - 5.9	3	29	20	6	2	1							63	961
6.0 - 6.9	5	33	34	16	5	2							97	898
7.0 - 7.9	7	47	23	12	9	5	2	1					108	801
8.0 - 8.9	13	61	25	8	5	3	3	2	1				124	693
9.0 - 9.9	22	95	27	6	4	2	1		1				162	569
10.0 - 10.9	24	108	25	5	2	1	1						172	407
11.0 - 11.9	12	57	20	5	2		1						100	235
12.0 - 12.9	7	34	13	4	1								62	134
13.0 - 13.9	4	18	8	3	1		1						36	72
14.0 - 14.9	2	10	4	2	1	1							20	36
15.0 - 15.9	1	7	4	1									14	16
16.0 - 16.9	6	1											1	2
TOTAL	131	528	209	67	33	15	9	3	5	1	1	1	1	1
CUM. TOTAL	1000	870	342	133	65	33	17	9	5	2	1	1		
COL. AVG.	8.71	8.49	8.02	7.72	7.75	7.67	8.29	8.09	8.97	9.33	9.50	10.17	6.33	

AVERAGE SIG. HEIGHT = 1.97 FT
 VARIANCE OF SIG. HEIGHT = 1.50 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.24 FT

AVERAGE WAVE PERIOD = 8.32 SEC
 VARIANCE OF WAVE PERIOD = 6.13 SEC SQ
 STANDARD DEVIATION OF PERIOD = 2.49 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT 15TH STREET PIER
 * CALMS ARE OMITTED.

1067 OBSERVATIONS

SUMMARY FOR 11 MONTHS DEC 68 THROUGH OCT 69

PERIOD (SECS)	SIG. HEIGHT (FT)												CUM. TOT. #	ROW
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	TOT. #	TOT. #	AVG. #
0.0 - .9													1000	0.00
1.0 - 1.9													1000	0.00
2.0 - 2.9	1	6	3										9	1000
3.0 - 3.9	3	28	19	5									54	991
4.0 - 4.9	2	23	33	15	4	1							78	936
5.0 - 5.9		28	43	18	8	9	1						108	858
6.0 - 6.9		26	25	7	5	7	5						74	751
7.0 - 7.9	3	40	21	7	4	6	2	1	1				84	677
8.0 - 8.9	12	133	62	11	6	3	1	2		2	1		232	592
9.0 - 9.9	6	67	31	8	2	3	1		2				120	360
10.0 - 10.9	12	40	30	7	3	4	3	1	1	1			102	240
11.0 - 11.9														138
12.0 - 12.9	8	37	17	12	8	5	1						88	138
13.0 - 13.9														50
14.0 - 14.9	4	7	11	7	7	7	1	1					44	50
15.0 - 15.9														6
16.0 - 16.9		4	2										6	6
TOTAL	51	440	246	97	46	43	14	5	4	3	1			
CUM. TOTAL	1000	949	509	213	115	69	26	12	7	4	1			
COL. AVG.	9.61	8.33	7.82	8.03	9.09	8.91	8.63	9.90	9.25	9.17	8.50	8.29		

AVERAGE SIG. HEIGHT = 2.38 FT
 VARIANCE OF SIG. HEIGHT = 1.90 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.38 FT

AVERAGE WAVE PERIOD = 8.12 SEC
 VARIANCE OF WAVE PERIOD = 7.92 SEC SQ
 STANDARD DEVIATION OF PERIOD = 2.81 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT 15TH STREET PIER
 * CALMS ARE OMITTED.

Table 15. Regression equations used to compensate significant height statistics for Virginia Beach, Virginia.

Date	Compensation equations (ft)
1962 to Mar. 1964	$H_{NEW} = 0.23 + 0.76 H_{OLD}$
Apr. 1964 to 1968	No compensation

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis (based on reanalysis of 2 months of data from Atlantic City, New Jersey).

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

Table A-16. CERC wave gage history for Jennettes Fishing Pier, Nags Head, North Carolina.

CERC Form 174-74 18 Mar 74		LOCATION: Jennettes Fishing Pier, Nags Head, North Carolina							
COORDINATES: 35°55' N., 75°36' W.		Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Type of Gage		8 Oct. 1963	9 July 1964	Recorder struck by lightning.	25	-7 to +18	17	153 ft (on north side of pier)	750
Step-resistance, staff-relay type		21 July 1964	28 May 1965	Gage struck by lightning.					
		13 June 1965	29 July 1966	Gage struck by lightning.					
		9 Aug. 1966	1 July 1971	Gage struck by lightning.					
		28 Aug. 1971	6 July 1972	Electronic trouble.					
		7 Aug. 1972	31 Oct. 1972	New gage installed.					
Continuous-wire staff		3 Nov. 1972	29 May 1973	Pier damaged by storm.	25	-8 to +17	17	153 ft (on north side of pier)	750
		15 Mar. 1974	10 May 1974	Gage struck by lightning.			16		
		13 June 1974	23 June 1974	Gage struck by lightning.					
		27 Aug. 1974	17 Oct. 1974	Gage struck by lightning.					
		14 Nov. 1974		Still operative as of 1 Feb. 1975.					

Table A-17. Number of analyzed records from Nags Head, North Carolina.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1964							102	127	83	171	161	177	821
1965	171	137	148	179	160	86	126	73	133	181	64	42	1500
1966	150	167	177	176	93	129	168	128	178	120	146	152	1784
1967	136	81	54	108	105	144	171	68					867
1968												96	96
1969	112	103	106	90	85	48	112	94	105	55			910
1970													
1971			40	111	105	91	22		117	117	78	120	802
1972	82	116	123	110	120	101		88	106	109	96	97	1148
1973	97	92	114	54	89								446
1974			43	73	32	22			75	50	54	118	467
1975	93												

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the CERC method. Results after November 1968 obtained from 1,024-second digital records taken four times daily.

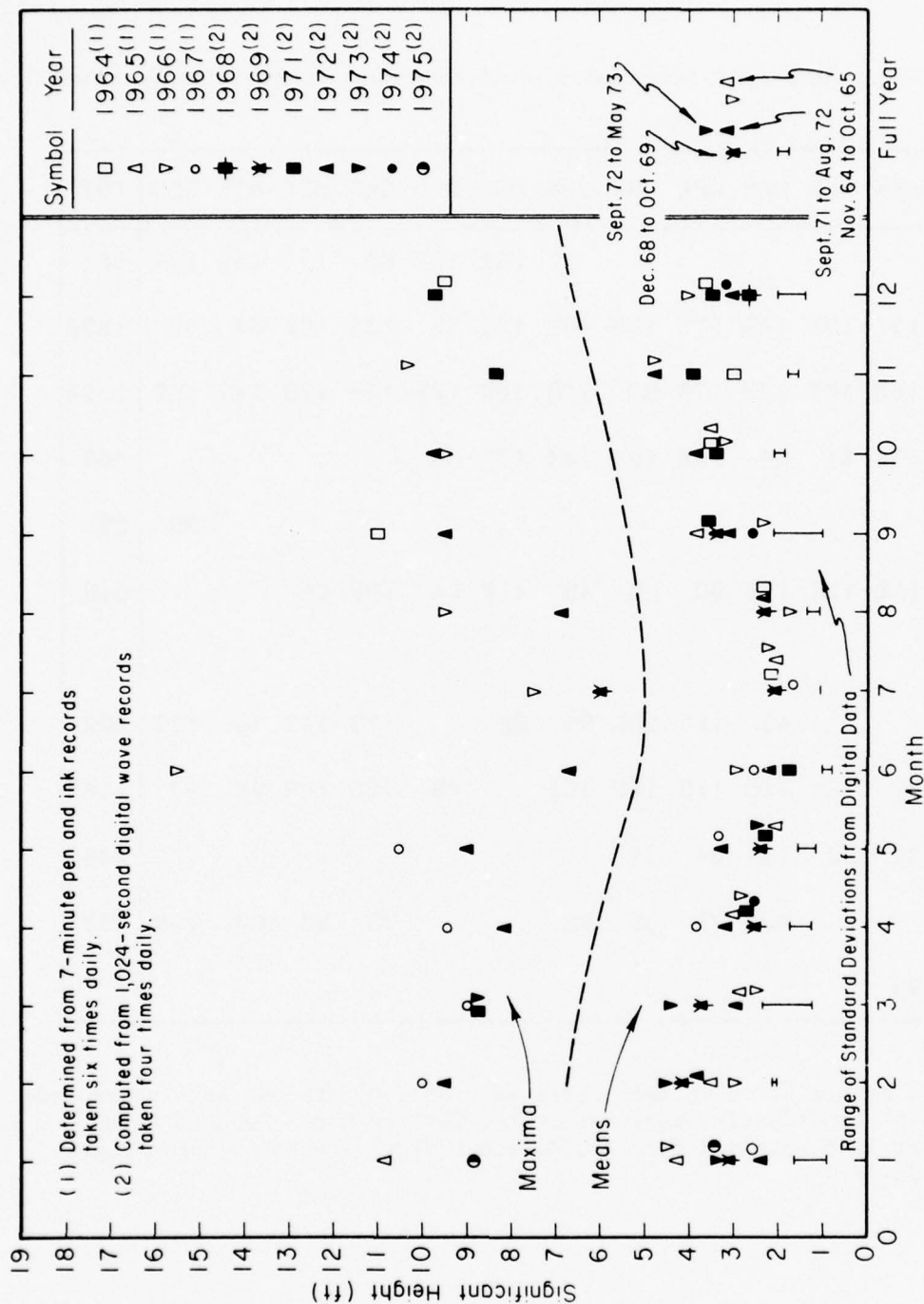


Figure A-28. Maxima, means, and standard deviations of significant height from Nags Head, North Carolina.

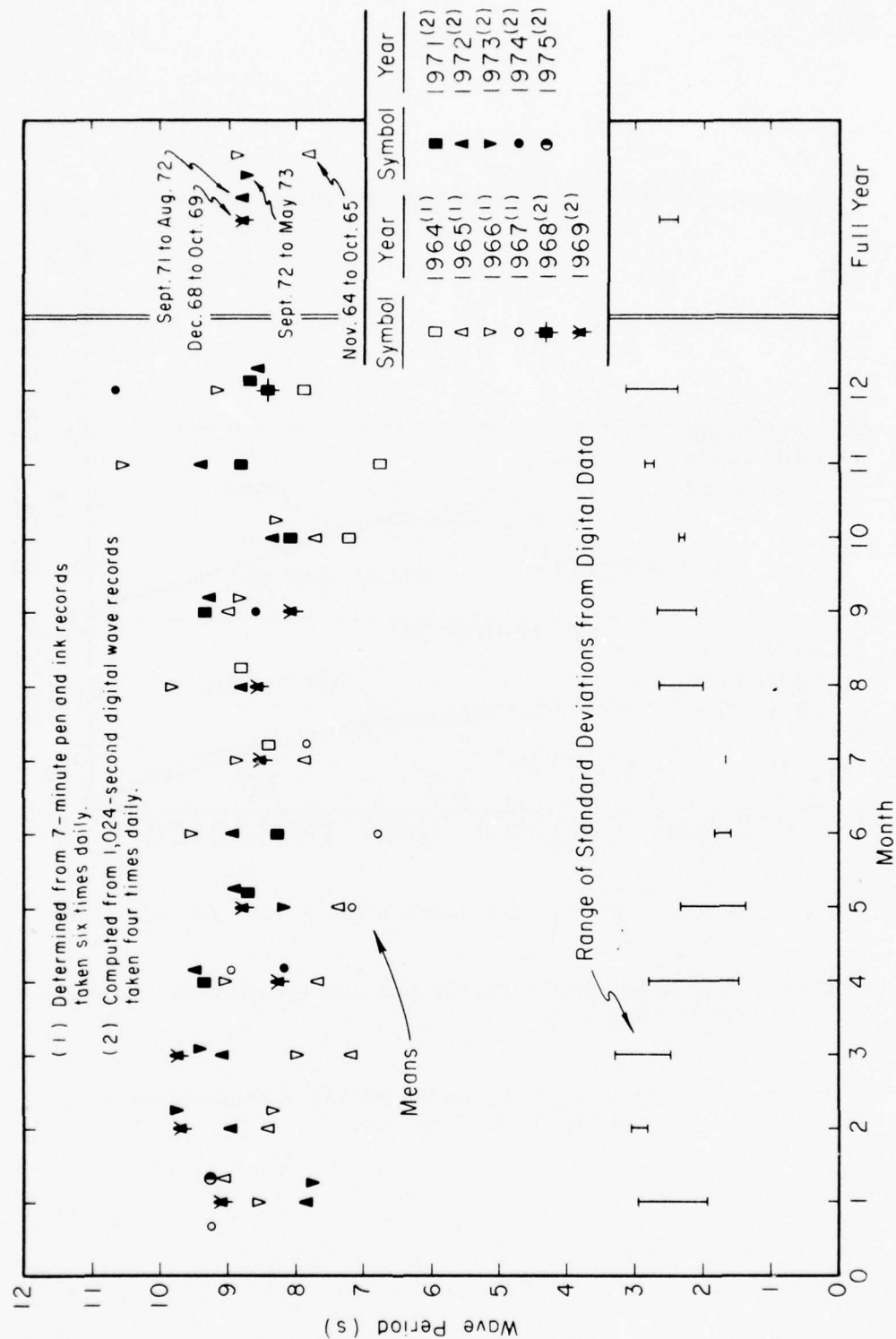
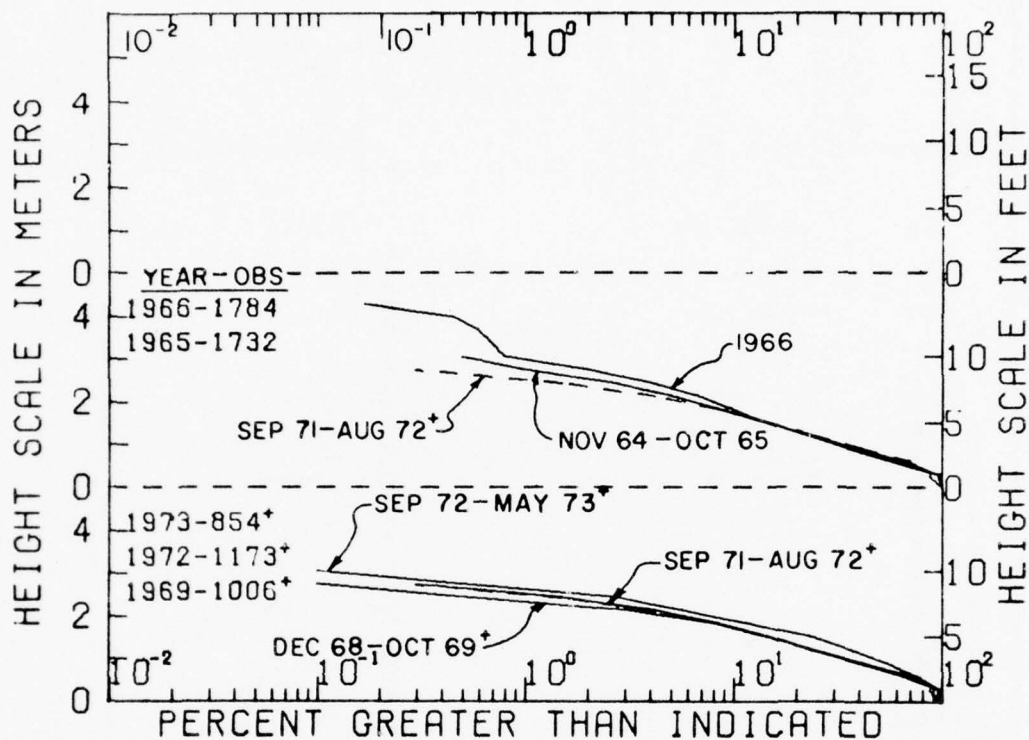


Figure A-29. Means and standard deviations of wave periods for Nags Head, North Carolina



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-30. Cumulative significant height distributions from Nags Head, North Carolina.

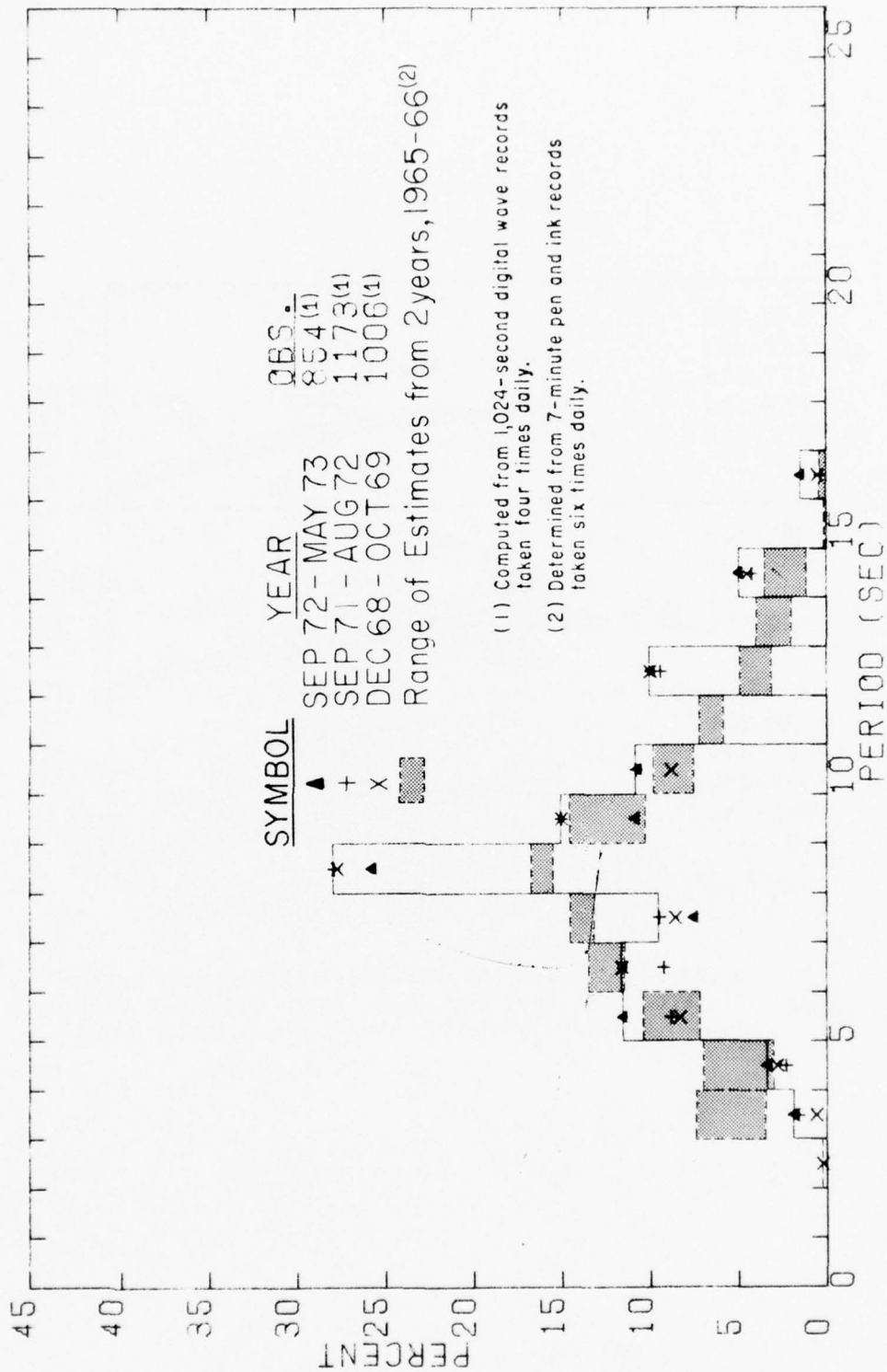


Figure A-31. Annual significant period distributions from Nags Head, North Carolina.

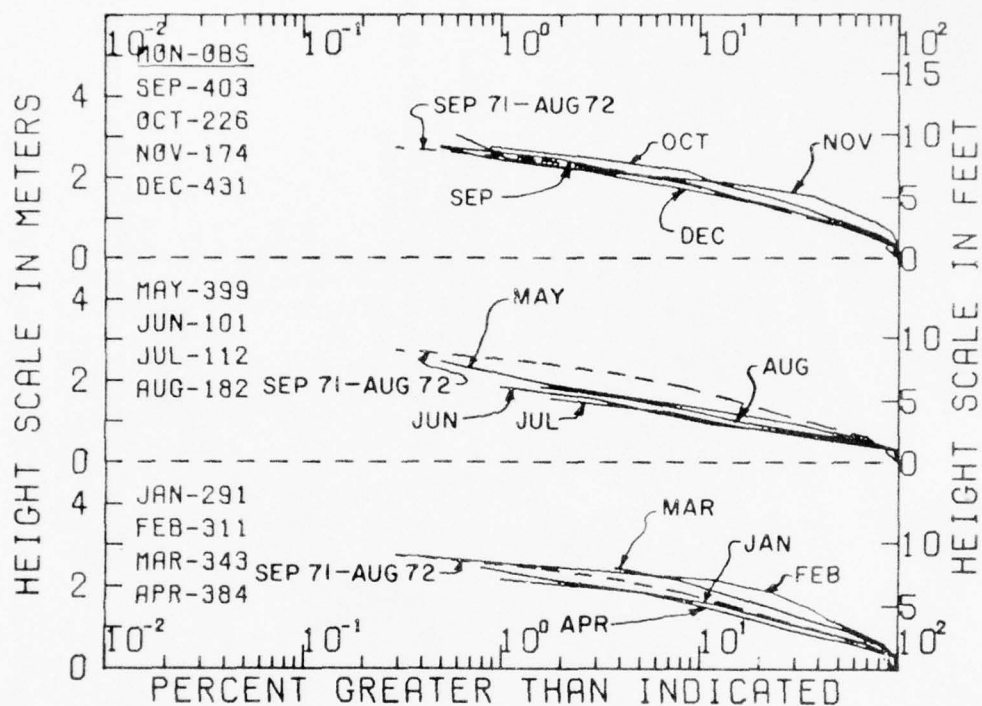


Figure A-32. Seasonal summaries of cumulative significant height distributions from Nags Head, North Carolina; computed from 1,024-second digital wave records taken four times daily.

Table A-18. Wave climate for Nags Head, North Carolina.
Distribution of significant height versus period
(in observations per 1,000 observations).

291 OBSERVATIONS

SUMMARY FOR JAN 69 JAN 72 JAN 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.	CUM. TOT.	WCL. AVG.
0.0 = 1.9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9		3							3	1000	1.40
3.0 = 3.9		14	14	3					21	997	2.40
4.0 = 4.9		27	27		3				45	976	2.35
5.0 = 5.9		27	38	45	27	3			141	951	3.09
6.0 = 6.9		24	24	52	27	27	7		162	790	3.69
7.0 = 7.9		10	31	10	10	10	7		79	629	3.50
8.0 = 8.9	10	76	89	21	7	24	3		230	550	2.60
9.0 = 9.9		55	31	10	10		7		113	320	2.53
10.0 = 10.9	3	34	14	14		3			69	206	2.25
11.0 = 11.9										137	0.00
12.0 = 12.9		31	17	24	7	7	7	7	100	137	3.40
13.0 = 13.9										38	0.00
14.0 = 14.9	3	3	7		3		10	3	31	38	4.28
15.0 = 15.9										7	0.00
16.0 = 16.9	3			3					7	7	2.00
TOTAL	21	282	292	182	96	76	41	10			2.99
CUM. TOTAL	1000	979	698	405	223	127	52	10			
COL. AVG.	11.17	8.62	7.81	7.93	7.43	7.95	10.33	13.17	8.26		

AVERAGE SIG. HEIGHT = 2.96 FT AVERAGE WAVE PERIOD = 8.29 SEC
VARIANCE OF SIG. HEIGHT = 2.21 FT SQ VARIANCE OF WAVE PERIOD = 6.65 SEC SQ
STANDARD DEVIATION OF HEIGHT = 1.48 FT STANDARD DEVIATION OF PERIOD = 2.58 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
WAVE GAGE LOCATED AT JENNETTES PIER.
• CALMS ARE OMITTED.

311 OBSERVATIONS

SUMMARY FOR FEB 69 FEB 72 FEB 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.	CUM. TOT.	WCL. AVG.
0.0 = 1.9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9		3	6	10							19	1000	2.83
4.0 = 4.9	3	3	6	6							19	981	2.33
5.0 = 5.9	3	10	42	29	23	10	3				119	961	3.34
6.0 = 6.9		13	29	10	26	23	23	6			129	842	4.39
7.0 = 7.9		3	6	13	23	10	3	6			64	714	4.50
8.0 = 8.9	3	10	29	16	16	16	29	6	6		132	650	4.52
9.0 = 9.9		19	26	26	3	6	13	3			96	518	3.70
10.0 = 10.9	3	19	16	35	13	6	23	3		3	122	421	4.00
11.0 = 11.9												299	0.00
12.0 = 12.9	3	32	35	23	10	23	23	23			170	299	4.10
13.0 = 13.9												129	0.00
14.0 = 14.9		26	32	6		3	10	42	3		122	129	4.61
15.0 = 15.9												6	0.00
16.0 = 16.9												6	8.00
TOTAL	16	158	228	174	113	96	113	103	16	3			4.10
CUM. TOTAL	1000	984	846	617	444	331	235	122	19	3			
COL. AVG.	8.30	10.34	9.13	8.69	7.84	8.97	9.70	12.06	11.50	10.50	9.45		

AVERAGE SIG. HEIGHT = 4.10 FT AVERAGE WAVE PERIOD = 9.45 SEC
VARIANCE OF SIG. HEIGHT = 4.23 FT SQ VARIANCE OF WAVE PERIOD = 8.91 SEC SQ
STANDARD DEVIATION OF HEIGHT = 2.06 FT STANDARD DEVIATION OF PERIOD = 2.99 SEC

343 OBSERVATIONS

SUMMARY FOR MAR 69 MAR 72 MAR 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.	CUM. TOT.	HU AVG.
0.0 = 1.9											1000	0.00
1.0 = 1.9											1000	0.00
2.0 = 2.9											1000	0.00
3.0 = 3.9		3	9	5						15	1000	2.40
4.0 = 4.9		9	9	9						26	485	2.40
5.0 = 5.9		9	32	32	17	5			3	96	959	3.16
6.0 = 6.9		6	23	29	6	12	3		6	85	863	3.88
7.0 = 7.9		9	17	12	9	12	3		6	67	778	3.93
8.0 = 8.9	3	61	47	50	44	6		9	3	222	711	3.17
9.0 = 9.9		26	38	32	9	12	3	3		125	490	3.31
10.0 = 10.9		50	17	23	6	12	12		6	125	364	3.31
11.0 = 11.9											239	0.00
12.0 = 12.9		26	23	26	26	12	15	6	6	140	239	4.00
13.0 = 13.9											99	0.00
14.0 = 14.9		12	12	6	6	9	15	6	9	73	99	4.86
15.0 = 15.9											26	0.00
16.0 = 16.9					6	6		12	3	26	26	6.50
TOTAL	3	210	227	222	128	82	50	41	38			3.64
CUM. TOTAL	1000	997	787	560	338	210	128	79	38			
COL. AVG.	8.50	9.47	8.49	8.51	9.55	10.18	11.79	12.14	10.96	9.38		

AVERAGE SIG. HEIGHT = 3.62 FT AVERAGE WAVE PERIOD = 9.39 SEC
 VARIANCE OF SIG. HEIGHT = 3.64 FT SQ VARIANCE OF WAVE PERIOD = 8.09 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.91 FT STANDARD DEVIATION OF PERIOD = 2.84 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT JENNETTES PIER.
 * CALMS ARE OMITTED.

344 OBSERVATIONS

SUMMARY FOR APR 69 APR 71 APR 72 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.	CUM. TOT.	HU AVG.
0.0 = 1.9											1000	0.00
1.0 = 1.9											1000	0.00
2.0 = 2.9		5	3							8	1000	1.83
3.0 = 3.9		10	5							16	992	1.83
4.0 = 4.9		8	8	13						29	977	2.68
5.0 = 5.9		31	16	16	13	5				81	948	2.82
6.0 = 6.9	3	23	29	10	8	5	5			83	867	2.91
7.0 = 7.9		13	18	5	8	10	5			60	784	3.50
8.0 = 8.9	16	128	78	16	16	3	3	3	3	263	724	2.25
9.0 = 9.9	5	65	81	44	16	8	5	5	3	232	461	2.87
10.0 = 10.9		39	26	8	16	10	5	3		107	229	3.11
11.0 = 11.9											122	0.00
12.0 = 12.9	5	26	13	8	5	3	10		3	73	122	3.14
13.0 = 13.9											49	0.00
14.0 = 14.9		26	13	5						44	49	2.03
15.0 = 15.9											5	0.00
16.0 = 16.9		5								5	5	1.50
TOTAL	29	380	289	125	81	44	34	10	8			2.72
CUM. TOTAL	1000	971	591	302	177	96	52	18	8			
COL. AVG.	9.23	8.97	8.73	8.48	8.56	8.56	9.73	9.50	10.17	8.84		

AVERAGE SIG. HEIGHT = 2.70 FT AVERAGE WAVE PERIOD = 8.90 SEC
 VARIANCE OF SIG. HEIGHT = 2.27 FT SQ VARIANCE OF WAVE PERIOD = 5.73 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.51 FT STANDARD DEVIATION OF PERIOD = 2.39 SEC

BEST AVAILABLE COPY

399 OBSERVATIONS

SUMMARY FOR MAY 69 MAY 71 MAY 72 MAY 73

PERIOD
(SECS)

810, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.	CUM. TOT.	ROW AVG.	
0.0 = .9											1000	0.00	
1.0 = 1.9											1000	0.00	
2.0 = 2.9											1000	0.00	
3.0 = 3.9			3	10	3					15	1000	2.50	
4.0 = 4.9			3	3	10	8				23	985	3.50	
5.0 = 5.9			5	15	18	8				48	967	3.29	
6.0 = 6.9	3	10	20	5	13			3		50	915	2.80	
7.0 = 7.9	5	30	35	13	5		3		3	93	865	2.55	
8.0 = 8.9	8	208	125	80	23	8	3			454	772	2.38	
9.0 = 9.9	5	63	45	43	15	10				180	318	2.67	
10.0 = 10.9	5	20	13	13	13	10	3	3		78	138	3.27	
11.0 = 11.9											60	0.00	
12.0 = 12.9			25	13		5		3	3	48	60	2.66	
13.0 = 13.9											13	0.00	
14.0 = 14.9		5	3							3	10	3.50	
15.0 = 15.9												3	0.00
16.0 = 16.9												3	2.50
TOTAL	25	371	283	183	88	30	10	5	5			2.68	
CUM. TOTAL	1000	974	604	321	138	50	20	10	5				
COL. AVG.	8.70	8.69	8.41	8.17	8.28	9.42	9.25	11.50	11.00	8.61			

AVERAGE 810, HEIGHT = 2.58 FT
 VARIANCE OF 810, HEIGHT = 1.48 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.22 FT

AVERAGE WAVE PERIOD = 8.68 SEC
 VARIANCE OF WAVE PERIOD = 3.29 SEC SQ
 STANDARD DEVIATION OF PERIOD = 1.82 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT JENNETTES PIER.
 * CALMS ARE OMITTED.

192 OBSERVATIONS

SUMMARY FOR JUN 71 JUN 72

PERIOD
(SECS)

810, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.	CUM. TOT.	ROW AVG.
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9									1000	0.00
3.0 = 3.9				5				5	1000	3.50
4.0 = 4.9			21					21	995	2.50
5.0 = 5.9		5	10	16				31	974	2.83
6.0 = 6.9		14	36	16	5			73	943	2.64
7.0 = 7.9		62	26	10				98	870	1.97
8.0 = 8.9	5	354	69	21	10	5	5	440	771	1.91
9.0 = 9.9		115	42		5	5		167	281	1.97
10.0 = 10.9		52	26					78	115	1.83
11.0 = 11.9									36	0.00
12.0 = 12.9		16	10					26	36	1.90
13.0 = 13.9									10	0.00
14.0 = 14.9									10	0.00
15.0 = 15.9									10	0.00
16.0 = 16.9									10	1.50
TOTAL	5	630	260	68	21	10	5			2.68
CUM. TOTAL	1000	945	365	104	36	16	5			
COL. AVG.	8.50	8.90	8.20	8.81	8.25	9.00	8.50	8.96		

AVERAGE 810, HEIGHT = 1.95 FT
 VARIANCE OF 810, HEIGHT = .80 FT SQ
 STANDARD DEVIATION OF HEIGHT = .89 FT

AVERAGE WAVE PERIOD = 8.60 SEC
 VARIANCE OF WAVE PERIOD = 2.94 SEC SQ
 STANDARD DEVIATION OF PERIOD = 1.71 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT JENNETTES PIER.
 * CALMS ARE OMITTED.

112 OBSERVATIONS

SUMMARY FOR JUL 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9		9					9	1000	1.50
3.0 = 3.9		9					9	991	1.50
4.0 = 4.9			9	9			18	982	3.00
5.0 = 5.9		27	9				36	964	1.75
6.0 = 6.9	9	36	18		9		71	929	2.00
7.0 = 7.9	18	27	9		27		80	857	2.39
8.0 = 8.9	18	339	89	18		18	482	777	1.87
9.0 = 9.9		71	71	45	18		205	295	2.54
10.0 = 10.9		54					54	89	1.50
11.0 = 11.9								36	0.00
12.0 = 12.9		27					27	36	1.50
13.0 = 13.9								9	0.00
14.0 = 14.9	9						9	9	.50
TOTAL	54	598	205	71	54	18			2.03
CUM. TOTAL	1000	946	348	143	71	18			
COL. AVG.	8.83*	8.51	8.33	8.63	8.00	8.50	8.47		

AVERAGE SIG. HEIGHT = 2.01 FT

AVERAGE WAVE PERIOD = 8.53 SEC*

VARIANCE OF SIG. HEIGHT = 1.04 FT SQ

VARIANCE OF WAVE PERIOD = 2.73 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.02 FT

STANDARD DEVIATION OF PERIOD = 1.65 SEC*

RESULTS OBTAINED FROM 1024*SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT JENNETTES PIEN,
 * CALMS ARE OMITTED.

182 OBSERVATIONS

SUMMARY FOR AUG 69 AUG 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9									1000	0.00
3.0 = 3.9		5	5					11	1000	2.00
4.0 = 4.9			16	5	5			27	989	3.10
5.0 = 5.9			27	22	11	11		71	962	3.58
6.0 = 6.9	5	27	33	5	11			82	890	2.37
7.0 = 7.9	5	77	27					110	808	1.70
8.0 = 8.9	16	198	126	33		11	11	396	698	2.19
9.0 = 9.9		77	16	22	16			132	302	2.33
10.0 = 10.9		11	27	5	5			49	170	2.61
11.0 = 11.9									121	0.00
12.0 = 12.9		16	16		5	5		44	121	2.75
13.0 = 13.9									77	0.00
14.0 = 14.9	22	33	11				5	71	77	1.73
15.0 = 15.9									5	0.00
16.0 = 16.9		5						5	5	1.50
TOTAL	49	451	308	93	55	27	16			2.30
CUM. TOTAL	1000	951	500	192	99	44	16			
COL. AVG.	10.83*	9.05	8.29	7.79	8.00	8.10	10.50	8.73		

AVERAGE SIG. HEIGHT = 2.26 FT

AVERAGE WAVE PERIOD = 8.68 SEC*

VARIANCE OF SIG. HEIGHT = 1.45 FT SQ

VARIANCE OF WAVE PERIOD = 5.47 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.20 FT

STANDARD DEVIATION OF PERIOD = 2.34 SEC*

403 OBSERVATIONS

SUMMARY FOR SEP 69 SEP 71 SEP 72 SEP 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	RU=
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9		2									2	1000	1.50
3.0 = 3.9		2	5	5							12	998	2.70
4.0 = 4.9			10	22	2						37	985	3.70
5.0 = 5.9		17	22	22	17	7	5				92	948	3.39
6.0 = 6.9	2	17	40	27	12	5	7				112	856	3.17
7.0 = 7.9		12	12	20	12	10					69	744	3.61
8.0 = 8.9	12	74	94	20	20	12	5		2	2	243	675	2.70
9.0 = 9.9	2	27	37	25	20	5	7	10			134	432	3.44
10.0 = 10.9	5	25	35	15	15	17	20	2	5		139	298	3.82
11.0 = 11.9												159	0.00
12.0 = 12.9	10	37	25	15	17	2	7	5	5		124	159	3.18
13.0 = 13.9												35	0.00
14.0 = 14.9	10	17	5		2						35	35	1.57
TOTAL	42	233	285	171	119	60	52	17	15	5			3.19
CUM. TOTAL	1000	958	725	439	268	149	89	37	20	5			
COL. AVG.	11.03*	9.37	8.54	7.67	8.79	8.63	9.40	10.50	10.33	6.50	8.82		

AVERAGE SIG. HEIGHT = 3.15 FT

AVERAGE WAVE PERIOD = 8.85 SEC*

VARIANCE OF SIG. HEIGHT = 3.08 FT SQ

VARIANCE OF WAVE PERIOD = 6.01 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.75 FT

STANDARD DEVIATION OF PERIOD = 2.45 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE

* WAVE GAGE LOCATED AT JENNETTES PIER,

* CALMS ARE OMITTED.

226 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	RU=
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9		4	9								13	1000	2.17
4.0 = 4.9			18	9	4	4					35	987	3.38
5.0 = 5.9		13	22	49	40	4					128	451	3.50
6.0 = 6.9	9	35	27	31	13	9		4			128	823	2.91
7.0 = 7.9		31	40	35	9	18		4		4	142	695	3.41
8.0 = 8.9	18	66	88	31	27	27	13	9	4		283	553	3.16
9.0 = 9.9		18	22		9	9	18	9	4		88	270	4.40
10.0 = 10.9		13	9	9		22		9		4	66	181	4.57
11.0 = 11.9												115	0.00
12.0 = 12.9		9	9	4	27	4	4	22	9		88	115	5.25
13.0 = 13.9												27	0.00
14.0 = 14.9		4	13						4		22	27	3.50
15.0 = 15.9												4	0.00
16.0 = 16.9		4									4	4	1.50
TOTAL	27	199	257	168	128	97	35	58	22	9			3.59
CUM. TOTAL	1000	973	774	518	350	221	124	88	31	9			
COL. AVG.	7.83*	8.39	8.03	7.05	8.09	8.55	9.50	10.27	11.50	9.00	9.25		

AVERAGE SIG. HEIGHT = 3.55 FT

AVERAGE WAVE PERIOD = 8.21 SEC*

VARIANCE OF SIG. HEIGHT = 3.79 FT SQ

VARIANCE OF WAVE PERIOD = 5.45 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.95 FT

STANDARD DEVIATION OF PERIOD = 2.34 SEC*

BEST AVAILABLE COPY

174 OBSERVATIONS

SUMMARY FOR NOV 71 NOV 72

PERIOD (SECS)	SIG. HEIGHT (FT)										CUM. ROW	TOT. #	AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT. #	TOT. #	AVG. #	
0.0 = .9											1000	0.00	
1.0 = 1.9											1000	0.00	
2.0 = 2.9											1000	0.00	
3.0 = 3.9											1000	0.00	
4.0 = 4.9											1000	0.00	
5.0 = 5.9											1000	0.00	
6.0 = 6.9											1000	0.00	
7.0 = 7.9											1000	0.00	
8.0 = 8.9											1000	0.00	
9.0 = 9.9											1000	0.00	
10.0 = 10.9											1000	0.00	
11.0 = 11.9											1000	0.00	
12.0 = 12.9											1000	0.00	
13.0 = 13.9											1000	0.00	
14.0 = 14.9											1000	0.00	
15.0 = 15.9											1000	0.00	
16.0 = 16.9											1000	0.00	
TOTAL											1000	0.00	
CUM. TOTAL	1000	1000	937	747	529	379	138	23	6		1000	0.00	
COL. AVG.	0.00	10.23	9.59	8.61	7.42	6.12	11.00	7.17	6.50	9.08			

AVERAGE SIG. HEIGHT = 4.26 FT

AVERAGE WAVE PERIOD = 9.13 SECS

VARIANCE OF SIG. HEIGHT = 2.50 FT SQ

VARIANCE OF WAVE PERIOD = 8.04 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.58 FT

STANDARD DEVIATION OF PERIOD = 2.84 SECS

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE

WAVE GAGE LOCATED AT JENNETT PIER.

* CALMS ARE OMITTED.

431 OBSERVATIONS

SUMMARY FOR DEC 68 DEC 71 DEC 72 DEC 74

PERIOD (SECS)	SIG. HEIGHT (FT)										CUM.	ROW	
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	TOT.*	AVG.*
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9	2		12	2							16	1000	2.36
4.0 = 4.9		7	12	5	2						26	984	2.59
5.0 = 5.9	2	12	23	28	19	7	12				102	958	3.64
6.0 = 6.9	2	16	16	32	21	12	7		2		111	856	3.77
7.0 = 7.9	5	19	7	21	23	14	7	2			97	745	3.74
8.0 = 8.9	21	42	58	28	35	19		12	2	5	220	647	3.29
9.0 = 9.9	16	24	28	14	9	9					104	427	2.63
10.0 = 10.9	5	24	30	23	2	7	2	2			95	323	2.74
11.0 = 11.9												227	0.00
12.0 = 12.9	5	63	26	21	9	2	2				128	227	2.37
13.0 = 13.9												100	0.00
14.0 = 14.9	5	39	12	7	12	5					79	100	2.44
15.0 = 15.9												21	0.00
16.0 = 16.9	2	14		2							21	21	1.61
TOTAL	65	264	223	183	132	74	30	19	5	5			3.05
CUM. TOTAL	1000	935	671	448	265	132	98	28	9	5			
COL. AVG.	9.46	10.69	8.71	8.53	8.43	8.53	7.12	8.25	7.50	8.50	9.14		

AVERAGE SIG. HEIGHT = 3.04 FT

VARIANCE OF SIG. HEIGHT = 2.80 FT SQ

STANDARD DEVIATION OF HEIGHT = 1.67 FT

AVERAGE WAVE PERIOD = 9.15 SECS

VARIANCE OF WAVE PERIOD = 8.17 SEC SQ

STANDARD DEVIATION OF PERIOD = 2.86 SECS

BEST AVAILABLE COPY

3400 OBSERVATIONS

SUMMARY FOR 34 MONTHS DEC 68 THROUGH DEC 74

PERIOD
(RECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.	CUM. TOT.	ROW. AVG.
0.0 = 1.0												1000	0.00
1.0 = 1.0												1000	0.00
2.0 = 2.0			1									2	1000 1.67
3.0 = 3.0			3	7	3							14	998 2.64
4.0 = 4.0			1	14	12	9	3					29	984 2.97
5.0 = 5.0			2	17	23	24	17	5	3			90	955 3.33
6.0 = 6.0			2	17	29	22	16	12	6	1	1	104	865 3.54
7.0 = 7.0			2	21	19	14	11	11	3	2	1	85	762 3.36
8.0 = 8.0			11	112	78	32	20	13	6	4	2	280	677 2.65
9.0 = 9.0			3	44	39	25	12	7	3	4	1	140	397 2.93
10.0 = 10.0			2	29	23	17	8	10	7	2	1	99	257 3.27
11.0 = 11.0													158 0.00
12.0 = 12.0			3	30	20	13	11	6	8	4	2	88	158 3.42
13.0 = 13.0													99 0.00
14.0 = 14.0			3	17	10	3	3	3	5	5	2	90	99 3.45
15.0 = 15.0													9 0.00
16.0 = 16.0			1	4	1	1	1	1	1	1	1	9	3.88
TOTAL	29	297	258	164	102	69	43	25	11	2			3.89
CUM. TOTAL	1000	971	674	416	252	149	80	38	13	2			
COL. AVG.	9.64	9.21	8.50	8.18	8.35	8.68	9.09	11.06	10.64	8.36	8.89		

AVERAGE SIG. HEIGHT = 3.07 FT
VARIANCE OF SIG. HEIGHT = 3.01 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.74 FT
AVERAGE WAVE PERIOD = 8.87 SEC
VARIANCE OF WAVE PERIOD = 0.36 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.52 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
WAVE GAGE LOCATED AT JENNETTES PIER.
* CALMS ARE OMITTED.

4328 OBSERVATIONS

SUMMARY FOR 29 MONTHS JUL 64 THROUGH JUL 67

PERIOD
(RECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	10=11	11=12	12=13	13=14	TOT.	CUM. TOT.	ROW. AVG.
0.0 = 1.0	1														1	1000	3.50
1.0 = 1.0		1													1	1000	1.63
2.0 = 2.0																26	998 1.00
3.0 = 3.0		1	20	5											22	972	2.02
4.0 = 4.0		1	10	9	1										92	950	2.53
5.0 = 5.0		1	14	25	10	2									93	899	2.96
6.0 = 6.0		1	20	30	25	11	5	1							133	806	3.45
7.0 = 7.0		4	47	29	17	13	11	7	6	3	1				140	673	3.32
8.0 = 8.0		6	43	27	12	9	4	4	5	4	1				157	533	2.64
9.0 = 9.0		5	49	24	10	9	4	3	3	3	1				132	376	2.68
10.0 = 10.0		5	35	21	9	5	4	3	2	2	1				88	244	2.90
11.0 = 11.0		2	18	14	12	5	3	3	2	2					61	156	3.14
12.0 = 12.0		2	10	8	5	5	3	2	2		1				38	95	3.54
13.0 = 13.0		1	9	7	4	2	2	2	1	1	1	1			31	57	3.73
14.0 = 14.0		1	7	4	2	2	1	2	1	1	1				21	26	3.74
15.0 = 15.0															1	0	1.03
16.0 = 16.0															0	0	2.02
TOTAL	33	371	239	137	83	50	32	26	16	8	3				2		2.98
CUM. TOTAL	1000	967	597	358	221	138	88	56	30	14	6	3	2				
COL. AVG.	9.14	8.38	7.93	7.88	8.19	8.48	9.35	9.08	9.67	10.99	11.14	8.50	9.59	9.72	8.32		

AVERAGE SIG. HEIGHT = 2.98 FT
VARIANCE OF SIG. HEIGHT = 3.88 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.96 FT
AVERAGE WAVE PERIOD = 8.32 SEC
VARIANCE OF WAVE PERIOD = 7.93 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.65 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT JENNETTES PIER
* CALMS ARE OMITTED.

Table A-19. CERC wave gage history for Johnny Mercer Pier, Wrightsville Beach, North Carolina.

CERC Form 174-74 18 Mar 74		LOCATION: Johnny Mercer Pier, Wrightsville Beach, North Carolina						
COORDINATES: 34°13' N., 77°47' W.								
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance, staff-relay type	19 Mar. 1970	27 Jan. 1972	Gage electronics vandalized.	25	-8 to +17	17	0	800
	31 Jan. 1972	24 July 1972	Gage struck by lightning.					
	9 Aug. 1972	18 Sept. 1972	Gage struck by lightning.					
	28 Oct. 1972	21 Mar. 1973	Power off at pier.					
	26 Mar. 1973	4 Aug. 1973	Gage struck by lightning.					
	4 Oct. 1973	31 May 1974	Gage struck by lightning.					
	20 July 1974	3 Nov. 1974	Gage ground disconnected by vandals.					
Continuous-wire staff	17 Jan. 1975		Still operative as of 1 Mar. 1975.					

Table A-20. Number of analyzed digital records from Wrightsville Beach, North Carolina.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1971			22	96	54	89	76	117	117	113	80	111	875
1972	88	116	119	111	120	109	65	78	67	14	117	82	1086
1973	81	88	88	60	96	75	65	6		62	79	43	743
1974	98	98	85	76	92	8	29	79	69	100	8		742

¹From 1,024-second records taken four times daily.

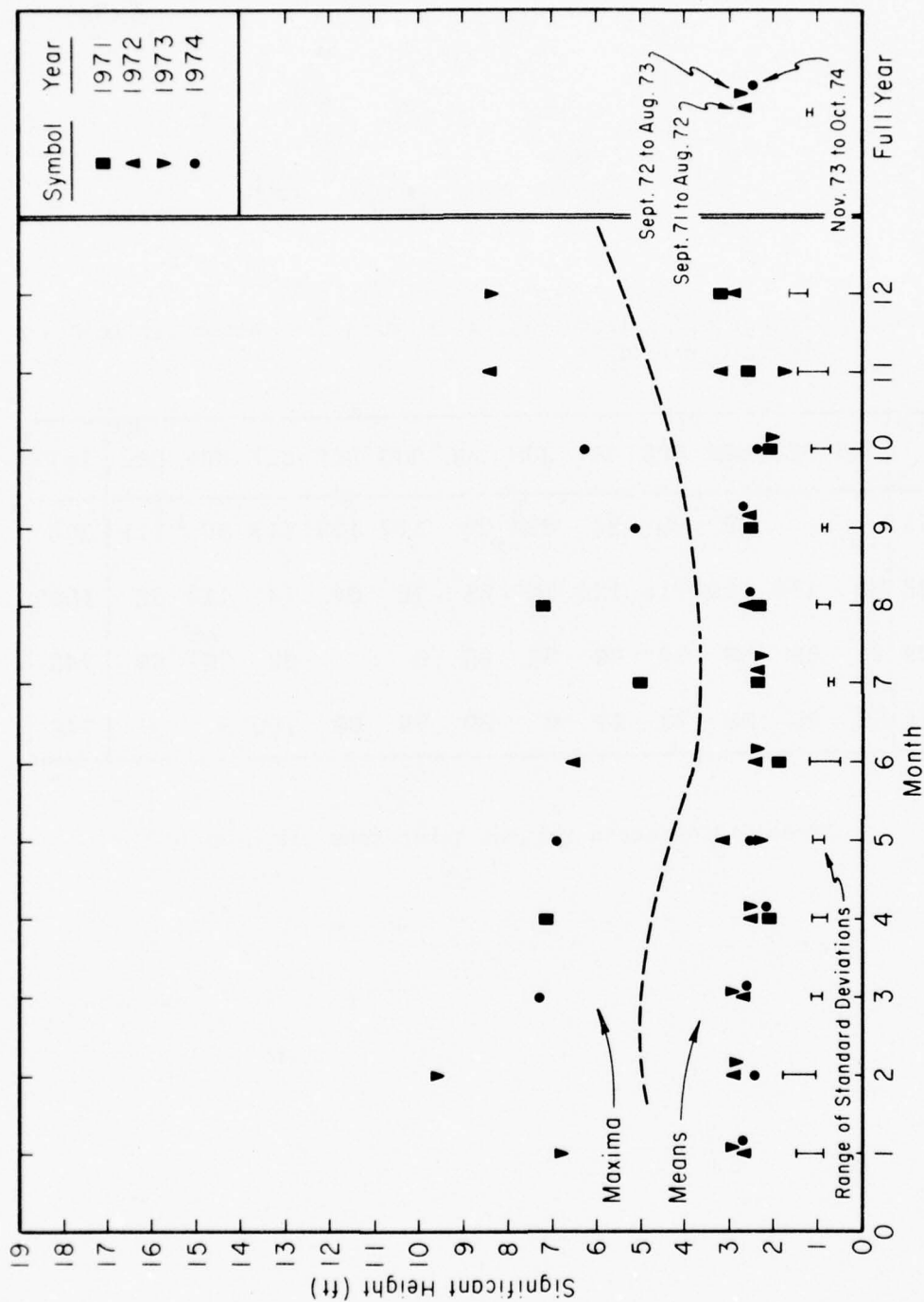


Figure A-33. Maxima, means, and standard deviations of significant height from Wrightsville Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

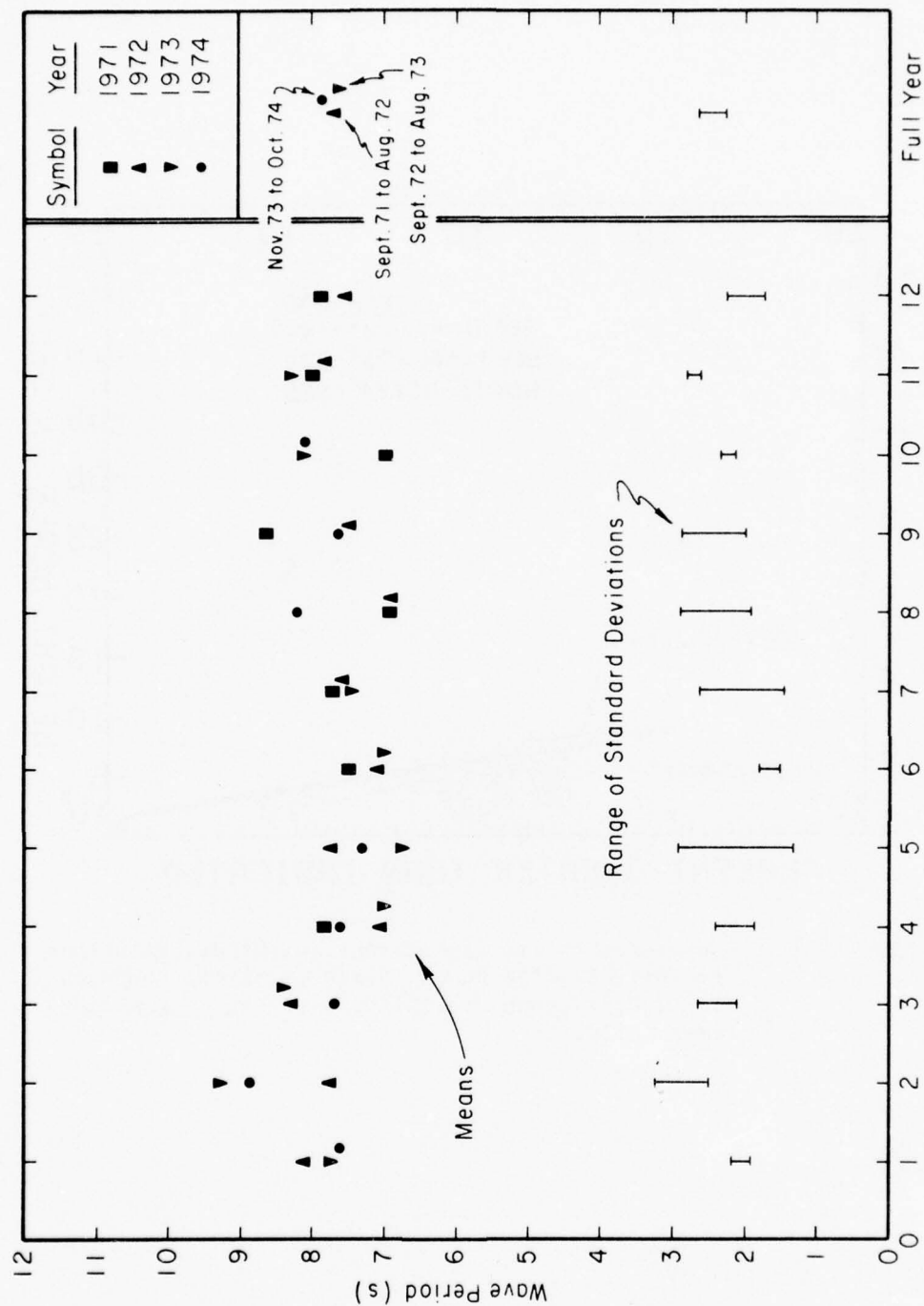


Figure A-34. Means and standard deviations of wave periods for Wrightsville Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

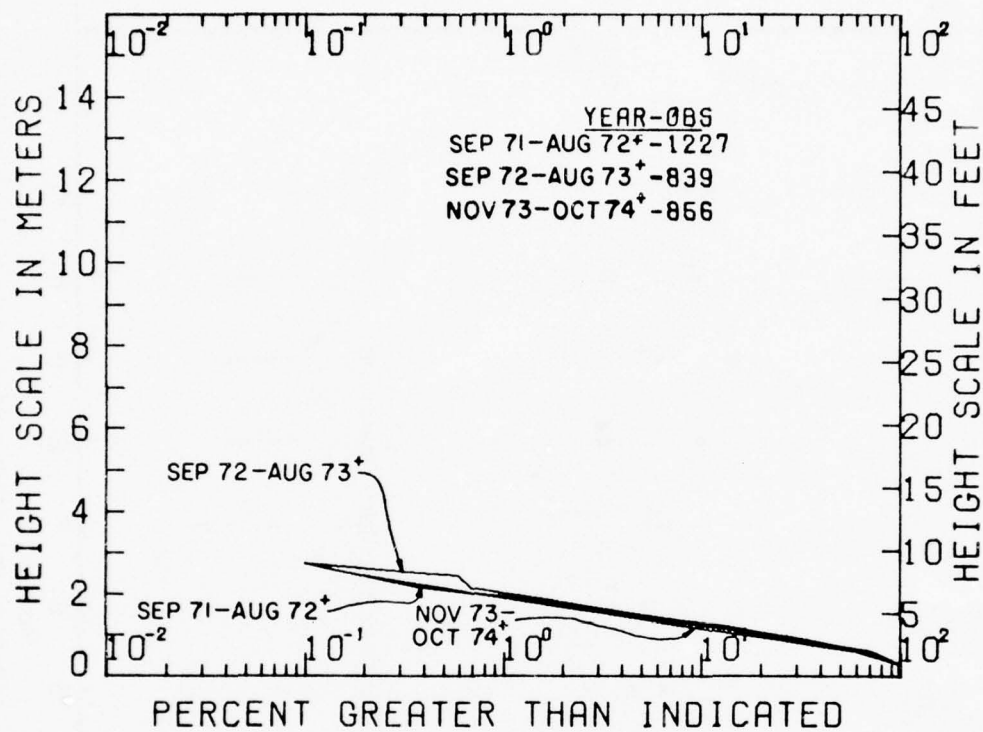


Figure A-35. Annual cumulative significant height distributions from Wrightsville Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

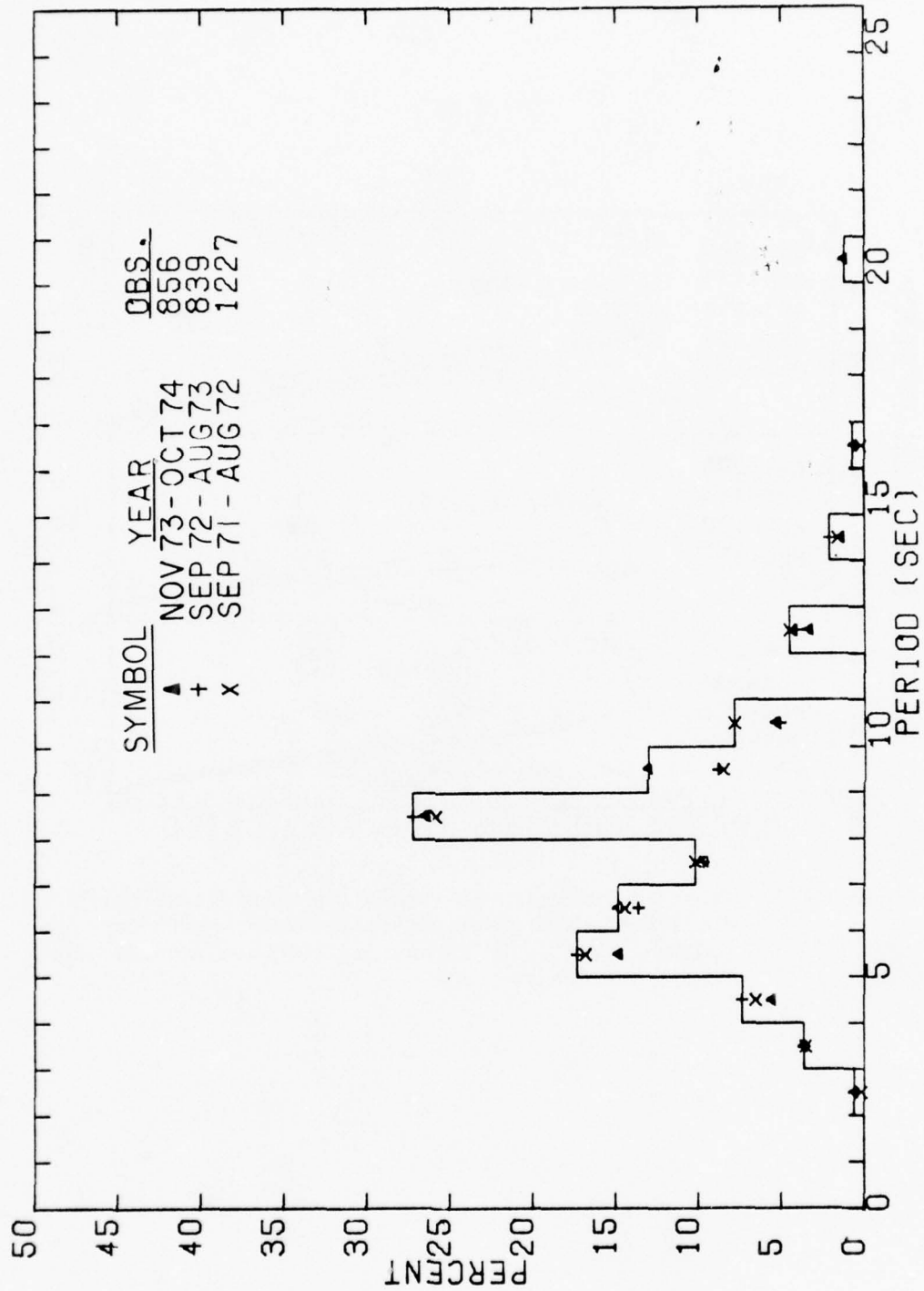


Figure A-36. Annual significant period distributions from Wrightsville Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

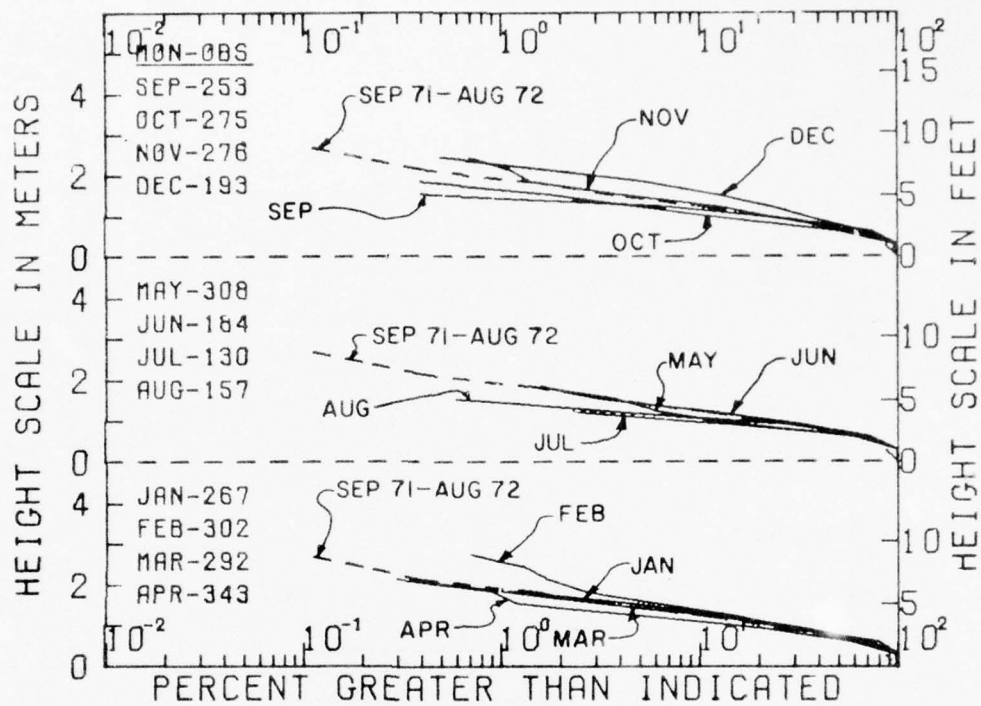


Figure A-37. Seasonal summaries of cumulative significant height distributions from Wrightsville Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

Table A-21. Wave climate for Wrightsville Beach, North Carolina.
Distribution of significant height versus period
(in observations per 1,000 observations).

267 OBSERVATIONS										SUMMARY FOR JAN 72 JAN 73 JAN 74		
PERIOD (SECS)	SIG. HEIGHT (FT)											
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*	
0.0 - .9									1000	0.00		
1.0 - 1.9									1000	0.00		
2.0 - 2.9									1000	0.00		
3.0 - 3.9			7	15	4			26	1000	2.16		
4.0 - 4.9			26	15	4			45	974	3.00		
5.0 - 5.9		22	37	45	26	11		142	929	3.26		
6.0 - 6.9	4	34	56	22	22	11		150	787	2.90		
7.0 - 7.9		19	11	30	26	4	7	97	637	3.58		
8.0 - 8.9	4	64	124	52	19	7	4	273	539	2.71		
9.0 - 9.9	4	67	67	19	4			161	266	2.20		
10.0 - 10.9		41	37	11				90	105	2.17		
11.0 - 11.9									15	0.00		
12.0 - 12.9		7	4					11	15	1.83		
13.0 - 13.9									4	0.00		
14.0 - 14.9									4	0.00		
15.0 - 15.9									4	0.00		
16.0 - 16.9									4	0.00		
17.0 - 17.9									4	0.00		
18.0 - 18.9									4	0.00		
19.0 - 19.9									4	0.00		
20.0 - 20.9				4				4	4	2.50		
21.0 +										0.00		
TOTAL	11	262	382	199	101	34	11			2.76		
CUM. TOTAL	1000	989	727	345	146	45	11					
COL. AVG.	8.17*	8.46	7.94	7.25	6.91	6.72	7.83	7.80				

AVERAGE SIG. HEIGHT = 2.73 FT AVERAGE WAVE PERIOD = 7.88 SEC*
VARIANCE OF SIG. HEIGHT = 1.21 FT SQ VARIANCE OF WAVE PERIOD = 4.33 SEC SQ*
STANDARD DEVIATION OF HEIGHT = 1.10 FT STANDARD DEVIATION OF PERIOD = 2.08 SEC*

RESULTS OBTAINED FROM 1024-8PCOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT JOHNNY MERCER PIER
* CALMS ARE OMITTED.

302 OBSERVATIONS										SUMMARY FOR FEB 72 FEB 73 FEB 74		
PERIOD (SECS)	SIG. HEIGHT (FT)											
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.* ROW TOT.*
0.0 - .9												1000 0.00
1.0 - 1.9												1000 0.00
2.0 - 2.9		10									10	1000 1.50
3.0 - 3.9		10	26	7							43	990 2.42
4.0 - 4.9		7	13	13	3						36	947 2.86
5.0 - 5.9		30	40	50	30						149	911 3.03
6.0 - 6.9		20	26	17	10	10			3		86	762 3.27
7.0 - 7.9	3	23	20	7	17	7	3				79	675 3.04
8.0 - 8.9	3	103	53	20	13	3	3		3	7	209	596 2.63
9.0 - 9.9		70	46	20	10	7	3	3			159	387 2.63
10.0 - 10.9		30	40	13		3					86	228 2.42
11.0 - 11.9												142 0.00
12.0 - 12.9	7	30	33	3							73	142 1.95
13.0 - 13.9												70 0.00
14.0 - 14.9	3	10	13	7							33	70 2.20
15.0 - 15.9												36 0.00
16.0 - 16.9		10	3	3	13	3					33	36 3.40
17.0 - 17.9												3 0.00
18.0 - 18.9												3 0.00
19.0 - 19.9												3 0.00
20.0 - 20.9				3							3	3 2.50
21.0 +												0.00
TOTAL	17	351	318	159	96	33	10	3	7	7		2.71
CUM. TOTAL	1000	983	632	315	156	60	26	17	13	7		
COL. AVG.	11.10*	8.78	8.58	7.58	8.28	8.90	8.50	9.50	7.50	8.50	8.51	

AVERAGE SIG. HEIGHT = 2.69 FT AVERAGE WAVE PERIOD = 8.88 SEC*
VARIANCE OF SIG. HEIGHT = 2.02 FT SQ VARIANCE OF WAVE PERIOD = 9.14 SEC SQ*
STANDARD DEVIATION OF HEIGHT = 1.42 FT STANDARD DEVIATION OF PERIOD = 3.02 SEC*

292 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 73 MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9										1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9										1000	0.00
3.0 - 3.9		10	21	3					34	1000	2.30
4.0 - 4.9		7	24	10	7				48	966	2.66
5.0 - 5.9		7	68	31	34	3	3		147	918	3.29
6.0 - 6.9	3	10	45	45	14	10		3	130	771	3.29
7.0 - 7.9		10	34	14	10				68	640	2.85
8.0 - 8.9	3	65	116	31	7	7	3		233	572	2.53
9.0 - 9.9		45	82	21	3				151	339	2.39
10.0 - 10.9		34	62		7				103	188	2.30
11.0 - 11.9										86	0.00
12.0 - 12.9		7	17	17	3				45	86	2.88
13.0 - 13.9										41	0.00
14.0 - 14.9		3	21	10	7				41	41	3.00
TOTAL	7	199	490	182	92	21	7	3			2.76
CUM. TOTAL	1000	993	795	305	123	31	10	3			
COL. AVG.	7.50*	8.66	8.23	7.93	7.46	7.00	7.00	6.50	6.15		

AVERAGE SIG. HEIGHT = 2.73 FT AVERAGE WAVE PERIOD = 8.18 SEC*
 VARIANCE OF SIG. HEIGHT = 1.07 FT SQ VARIANCE OF WAVE PERIOD = 6.15 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.03 FT STANDARD DEVIATION OF PERIOD = 2.48 SEC*
 RESULTS OBTAINED FROM 1024 SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT JOHNNY MERCER PIER
 * CALMS ARE OMITTED.

343 OBSERVATIONS

SUMMARY FOR APR 71 APR 72 APR 73 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9										1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9		6	6						12	1000	2.00
3.0 - 3.9		20	29		3				52	988	2.22
4.0 - 4.9		20	26	12	3				61	936	2.45
5.0 - 5.9	3	47	57	41	15				172	875	2.60
6.0 - 6.9	3	55	51	41					160	703	2.37
7.0 - 7.9		35	35	17	12				99	542	2.56
8.0 - 8.9	9	140	71	41	6	3	3	3	277	443	2.25
9.0 - 9.9	12	20	29	6			3		70	166	2.13
10.0 - 10.9		26	23	3	6				58	96	2.30
11.0 - 11.9										38	0.00
12.0 - 12.9		3	17	3					23	38	2.50
13.0 - 13.9										15	0.00
14.0 - 14.9		6	6						12	15	2.00
15.0 - 15.9										3	0.00
16.0 - 16.9										3	0.00
17.0 - 17.9										3	0.00
18.0 - 18.9										3	0.00
19.0 - 19.9										3	0.00
20.0 - 20.9		3							3	3	1.50
21.0 +											0.00
TOTAL	26	382	373	163	44	3	6	3			2.36
CUM. TOTAL	1000	974	592	219	55	12	9	3			
COL. AVG.	8.39*	7.58	7.26	7.00	6.90	8.50	9.00	8.50	7.37		

AVERAGE SIG. HEIGHT = 2.32 FT AVERAGE WAVE PERIOD = 7.41 SEC*
 VARIANCE OF SIG. HEIGHT = .88 FT SQ VARIANCE OF WAVE PERIOD = 5.17 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .94 FT STANDARD DEVIATION OF PERIOD = 2.27 SEC*

308 OBSERVATIONS

SUMMARY FOR MAY 72 MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9		10						10	1000	1.50
3.0 = 3.9			23					23	990	2.50
4.0 = 4.9			29	39	6			75	968	3.20
5.0 = 5.9		42	71	65	26			205	893	2.87
6.0 = 6.9		52	39	16	13	6		127	688	2.88
7.0 = 7.9		52	42	13	10	6	10	133	562	2.79
8.0 = 8.9	3	84	162	52	29	3	6	341	429	2.66
9.0 = 9.9		6	19	13				39	68	2.67
10.0 = 10.9		3	6	3				13	49	2.50
11.0 = 11.9									36	0.00
12.0 = 12.9		10	10	3				23	36	2.21
13.0 = 13.9									13	0.00
14.0 = 14.9			6					6	13	2.50
15.0 = 15.9									6	0.00
16.0 = 16.9									6	0.00
17.0 = 17.9									6	0.00
18.0 = 18.9									6	0.00
19.0 = 19.9									6	0.00
20.0 = 20.9			6					6	6	1.50
21.0 +										0.00
TOTAL	3	266	409	205	84	16	16			2.71
CUM. TOTAL	1000	997	731	321	117	32	16			
COL. AVG.	8.50*	7.71	7.39	6.72	6.85	7.30	7.90	7.30		

AVERAGE SIG. HEIGHT = 2.66 FT

AVERAGE WAVE PERIOD = 7.31 SEC*

VARIANCE OF SIG. HEIGHT = 1.11 FT SQ

VARIANCE OF WAVE PERIOD = 8.55 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.06 FT

STANDARD DEVIATION OF PERIOD = 2.13 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT JOHNNY MERCER PIER

* CALMS ARE OMITTED.

184 OBSERVATIONS

SUMMARY FOR JUN 72 JUN 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9		5						5	1000	1.50
3.0 = 3.9		11	27	5				43	995	2.38
4.0 = 4.9		11	33					43	951	2.25
5.0 = 5.9		27	87	49				163	908	2.63
6.0 = 6.9	5	76	98	16	11	16	5	228	745	2.60
7.0 = 7.9		43	49	11	5			120	516	2.68
8.0 = 8.9		179	147	11	5	5	11	348	397	2.09
9.0 = 9.9		27	5		5			38	49	2.07
10.0 = 10.9		5	5					11	11	2.00
TOTAL	5	386	451	92	27	22	16			2.38
CUM. TOTAL	1000	995	609	158	65	38	16			
COL. AVG.	6.50*	7.54	6.83	6.15	7.70	7.00	7.17	7.07		

AVERAGE SIG. HEIGHT = 2.38 FT

AVERAGE WAVE PERIOD = 7.10 SEC*

VARIANCE OF SIG. HEIGHT = .94 FT SQ

VARIANCE OF WAVE PERIOD = 2.42 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .97 FT

STANDARD DEVIATION OF PERIOD = 1.56 SEC*

130 OBSERVATIONS

SUMMARY FOR JUL 72 JUL 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9							1000	0.00
1.0 - 1.9							1000	0.00
2.0 - 2.9							1000	0.00
3.0 - 3.9			31			31	1000	2.50
4.0 - 4.9			46	A		54	969	2.64
5.0 - 5.9		69	46	31	A	154	915	2.35
6.0 - 6.9		77	38	38		154	762	2.25
7.0 - 7.9		31	62			92	608	2.17
8.0 - 8.9		108	238	31	15	392	515	2.38
9.0 - 9.9		15	38	A		62	123	2.38
10.0 - 10.9		A	A			15	62	2.00
11.0 - 11.9							46	0.00
12.0 - 12.9		A	31			38	46	2.30
13.0 - 13.9							A	0.00
14.0 - 14.9		A				A	A	1.50
TOTAL		323	538	115	23			2.34
CUM. TOTAL	1000	1000	677	138	23			
COL. AVG.	0.00*	7.62	7.69	6.83	7.50	7.56		

AVERAGE SIG. HEIGHT = 2.26 FT

VARIANCE OF SIG. HEIGHT = .47 FT SQ

STANDARD DEVIATION OF HEIGHT = .69 FT

AVERAGE WAVE PERIOD = 7.54 SEC

VARIANCE OF WAVE PERIOD = 3.89 SEC SQ

STANDARD DEVIATION OF PERIOD = 1.97 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT JOHNNY MERCER PIER

* CALMS ARE OMITTED.

157 OBSERVATIONS

SUMMARY FOR AUG 72 AUG 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW AVG.*
1.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9		6					6	1000	1.50
3.0 - 3.9			6	13			19	994	3.17
4.0 - 4.9			25	57	6	6	96	975	3.43
5.0 - 5.9		25	70	57	13		166	879	2.85
6.0 - 6.9		70	64	13	13		159	713	2.30
7.0 - 7.9		57	51	13			121	554	2.13
8.0 - 8.9		96	108	83			287	433	2.46
9.0 - 9.9		6	45	13			64	146	2.60
10.0 - 10.9			25				25	83	2.50
11.0 - 11.9								57	0.00
12.0 - 12.9			19				19	57	2.50
13.0 - 13.9								38	0.00
14.0 - 14.9		13	6				19	38	1.83
15.0 - 15.9								19	0.00
16.0 - 16.9		6					6	19	1.50
17.0 - 17.9								13	0.00
18.0 - 18.9								13	0.00
19.0 - 19.9								13	0.00
20.0 - 20.9		6		6			13	13	2.50
21.0 +									0.00
TOTAL		287	420	255	32	6			2.55
CUM. TOTAL	1000	1000	713	293	38	6			
COL. AVG.	0.00*	8.14	7.76	6.88	5.70	4.50	7.56		

AVERAGE SIG. HEIGHT = 2.52 FT

VARIANCE OF SIG. HEIGHT = .64 FT SQ

STANDARD DEVIATION OF HEIGHT = .80 FT

AVERAGE WAVE PERIOD = 7.57 SEC

VARIANCE OF WAVE PERIOD = 6.86 SEC SQ

STANDARD DEVIATION OF PERIOD = 2.62 SEC

253 OBSERVATIONS

SUMMARY FOR SEP 71 SEP 72 SEP 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9								1000	0.00
3.0 = 3.9		16	8	8			32	1000	2.25
4.0 = 4.9		4	59	36	8		107	968	2.94
5.0 = 5.9		4	47	55	16		123	862	3.18
6.0 = 6.9		28	51	16	20	4	119	739	2.83
7.0 = 7.9		32	24	12	8		75	621	2.45
8.0 = 8.9		40	130	28	8		206	545	2.52
9.0 = 9.9		32	40	20			91	340	2.37
10.0 = 10.9	4	59	47	20	4		134	249	2.21
11.0 = 11.9								115	0.00
12.0 = 12.9		24	51	20	4		99	115	2.54
13.0 = 13.9								16	0.00
14.0 = 14.9		8	4	4			16	16	2.25
TOTAL	4	245	462	217	67	4			2.61
CUM. TOTAL	1000	996	751	289	71	4			
COL. AVG.	10.50*	8.90	8.11	7.45	6.97	6.50	8.08		

AVERAGE SIG. HEIGHT = 2.55 FT

AVERAGE WAVE PERIOD = 8.11 SEC*

VARIANCE OF SIG. HEIGHT = .66 FT SQ

VARIANCE OF WAVE PERIOD = 6.84 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .81 FT

STANDARD DEVIATION OF PERIOD = 2.62 SEC*

RESULTS OBTAINED FROM 1024=SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT JOHNNY MERCER PIER

* CALMS ARE OMITTED.

275 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 73 OCT 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9		4						4	1000	1.50
3.0 = 3.9		22	11					33	996	1.83
4.0 = 4.9		22	29	11				62	964	2.32
5.0 = 5.9		33	84	29	7			153	902	2.57
6.0 = 6.9		58	73	22	4			156	749	2.31
7.0 = 7.9		65	55	4		4		127	593	2.10
8.0 = 8.9	11	124	84	18	22		4	265	465	2.28
9.0 = 9.9	7	40	18	7		7		80	200	2.18
10.0 = 10.9		40	7	4				51	120	1.79
11.0 = 11.9									69	0.00
12.0 = 12.9	7	29	7	4				47	69	1.65
13.0 = 13.9									22	0.00
14.0 = 14.9	4	7	4					15	22	1.50
15.0 = 15.9									7	0.00
16.0 = 16.9		7						7	7	1.50
TOTAL	29	451	371	98	33	15	4			2.21
CUM. TOTAL	1000	971	520	149	51	18	4			
COL. AVG.	10.50*	8.15	7.05	6.98	7.61	8.75	8.50	7.69		

AVERAGE SIG. HEIGHT = 2.14 FT

AVERAGE WAVE PERIOD = 7.65 SEC*

VARIANCE OF SIG. HEIGHT = .88 FT SQ

VARIANCE OF WAVE PERIOD = 5.51 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .94 FT

STANDARD DEVIATION OF PERIOD = 2.35 SEC*

276 OBSERVATIONS

SUMMARY FOR NOV 71 NOV 72 NOV 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9											1000	0.00	
1.0 = 1.9											1000	0.00	
2.0 = 2.9											1000	0.00	
3.0 = 3.9	4	4	7	14						29	1000	2.63	
4.0 = 4.9		7	51	25	7					91	971	2.86	
5.0 = 5.9		11	65	40	43					159	880	3.23	
6.0 = 6.9	4	36	33	4	22	14				112	721	2.92	
7.0 = 7.9	4	33	18	18	4	4	4			83	609	2.63	
8.0 = 8.9	14	105	83	29	4	7			7	250	525	2.37	
9.0 = 9.9	22	36	22	4	7			4		94	275	2.04	
10.0 = 10.9		36	14	4	4					58	181	2.06	
11.0 = 11.9											123	0.00	
12.0 = 12.9		47	29	4						80	123	1.95	
13.0 = 13.9											43	0.00	
14.0 = 14.9	4	18	11	4						36	43	1.90	
15.0 = 15.9											7	0.00	
16.0 = 16.9		4								4	7	1.50	
17.0 = 17.9											4	0.00	
18.0 = 18.9											4	0.00	
19.0 = 19.9											4	0.00	
20.0 = 20.9	4									4	4	.50	
21.0 *												0.00	
TOTAL	54	337	333	145	91	25	4	4	7			2.53	
CUM. TOTAL	1000	946	609	275	130	40	14	11	7				
COL. AVG.	9.57*	9.24	7.64	6.63	6.38	7.21	7.50	9.50	8.50	8.03			

AVERAGE SIG. HEIGHT = 2.54 FT

AVERAGE WAVE PERIOD = 8.03 SEC*

VARIANCE OF SIG. HEIGHT = 1.55 FT SQ

VARIANCE OF WAVE PERIOD = 7.32 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.25 FT

STANDARD DEVIATION OF PERIOD = 2.71 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT JOHNNY MERCER PIER

* CALMS ARE OMITTED.

193 OBSERVATIONS

SUMMARY FOR DEC 71 DEC 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9											1000	0.00	
1.0 = 1.9											1000	0.00	
2.0 = 2.9											1000	0.00	
3.0 = 3.9		10	10	10						31	1000	2.50	
4.0 = 4.9		10	31	5		5				52	969	2.70	
5.0 = 5.9		21	62	36	31		10			161	917	3.24	
6.0 = 6.9		21	47	26	26	10	10			140	756	3.43	
7.0 = 7.9		31	26	26	16	10	5			114	617	3.18	
8.0 = 8.9		83	47	21	31	36	5	10		233	503	3.28	
9.0 = 9.9		78	36	16	5	5	5		5	150	269	2.60	
10.0 = 10.9		31	36	16	5	5				93	119	2.61	
11.0 = 11.9											26	0.00	
12.0 = 12.9		21								21	26	1.50	
13.0 = 13.9											5	0.00	
14.0 = 14.9				5						5	5	3.50	
TOTAL		306	295	161	114	73	36	10	5			3.03	
CUM. TOTAL	1000	1000	694	399	238	124	52	16	5				
COL. AVG.	0.00*	8.48	7.24	7.37	7.23	8.00	7.07	8.50	9.50	7.71			

AVERAGE SIG. HEIGHT = 2.97 FT

AVERAGE WAVE PERIOD = 7.77 SEC*

VARIANCE OF SIG. HEIGHT = 2.11 FT SQ

VARIANCE OF WAVE PERIOD = 4.27 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.45 FT

STANDARD DEVIATION OF PERIOD = 2.07 SEC*

2980 OBSERVATIONS

SUMMARY FOR 33 MONTHS APR 71 THROUGH OCT 74

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9												1000	0.00
1.0 - 1.9												1000	0.00
2.0 - 2.9		4	1								4	1000	1.65
3.0 - 3.9		10	18	5							34	996	2.35
4.0 - 4.9		8	32	19	4	1					64	962	2.83
5.0 - 5.9		27	62	44	22	1	1				158	898	2.93
6.0 - 6.9	2	42	51	23	13	7	1				140	740	2.73
7.0 - 7.9	1	35	34	14	10	3	3				100	600	2.70
8.0 - 8.9	5	98	108	34	13	6	3	1	1	1	269	500	2.49
9.0 - 9.9	4	38	38	12	3	2	1	1			99	231	2.36
10.0 - 10.9		28	27	6	2	1					65	132	2.26
11.0 - 11.9												66	0.00
12.0 - 12.9	1	16	18	5	1						42	66	2.20
13.0 - 13.9												24	0.00
14.0 - 14.9	1	6	7	3	1						17	24	2.26
15.0 - 15.9												7	0.00
16.0 - 16.9		2			1						5	7	2.86
17.0 - 17.9												3	0.00
18.0 - 18.9												3	0.00
19.0 - 19.9												3	0.00
20.0 - 20.9												3	1.88
21.0 *			1	1									0.00
TOTAL	15	316	397	167	70	21	9	2	2	1			2.58
CUM. TOTAL	1000	985	668	272	105	34	13	4	2	1			
COL. AVG.	9.41*	8.27	7.67	7.14	7.16	7.63	7.69	8.50	8.30	8.50	7.77		

AVERAGE SIG. HEIGHT = 2.55 FT

AVERAGE WAVE PERIOD = 7.79 SEC*

VARIANCE OF SIG. HEIGHT = 1.21 FT SQ

VARIANCE OF WAVE PERIOD = 5.88 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.10 FT

STANDARD DEVIATION OF PERIOD = 2.42 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RESISTANCE RELAY
WAVE GAGE LOCATED AT JOHNNY MERCER PIER

* CALMS ARE OMITTED.

Table A-22. CERC wave gage history for Holden Beach Pier, Holden Beach, North Carolina.

CERC Form 174-74 18 Mar 74		LOCATION: Holden Beach Pier, Holden Beach, North Carolina						
COORDINATES: 33°55' N., 78°18' W.								
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Continuous wire staff	5 Feb. 1971	9 June 1971		25	-8 to +17	15	0	700
	13 July 1971	20 July 1971	Gage struck by lightning.					
	27 Aug. 1971	16 Oct. 1971	Gage struck by lightning.					
	20 Oct. 1971	6 July 1972	Gage struck by lightning.					
	12 July 1972	5 Aug. 1972	Gage struck by lightning.					
	9 Aug. 1972	18 Sept. 1972	Gage struck by lightning.					
	27 Oct. 1972	17 Feb. 1973	Gage struck by lightning.					
	16 Mar. 1973	3 Sept. 1973	Gage damaged and badly rusted.					
	21 Nov. 1973	14 Dec. 1973	Signal cable cut by vandals.					
	16 Jan. 1974	2 May 1974	Gage struck by lightning.					
Continuous-wire staff	8 June 1974	14 June 1974	Gage struck by lightning.					
	19 July 1974	30 July 1974	Gage struck by lightning.					
	28 Aug. 1974		Still operative as of 1 Mar. 1975	25	-6 to +19	15	0	700

Table A-23. Number of analyzed digital records from Holden Beach, North Carolina.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1971				99	80	26	10	17	108	104	80	111	635
1972	102	105	82	99	87	118	75	94	68	16	113	93	1052
1973	90	53	48	56	56	48	60	89	9		35	17	561
1974	54	71	80	76		12	15		63	90	104	104	669
1975	94	66											

¹From 1,024-second records taken four times daily.

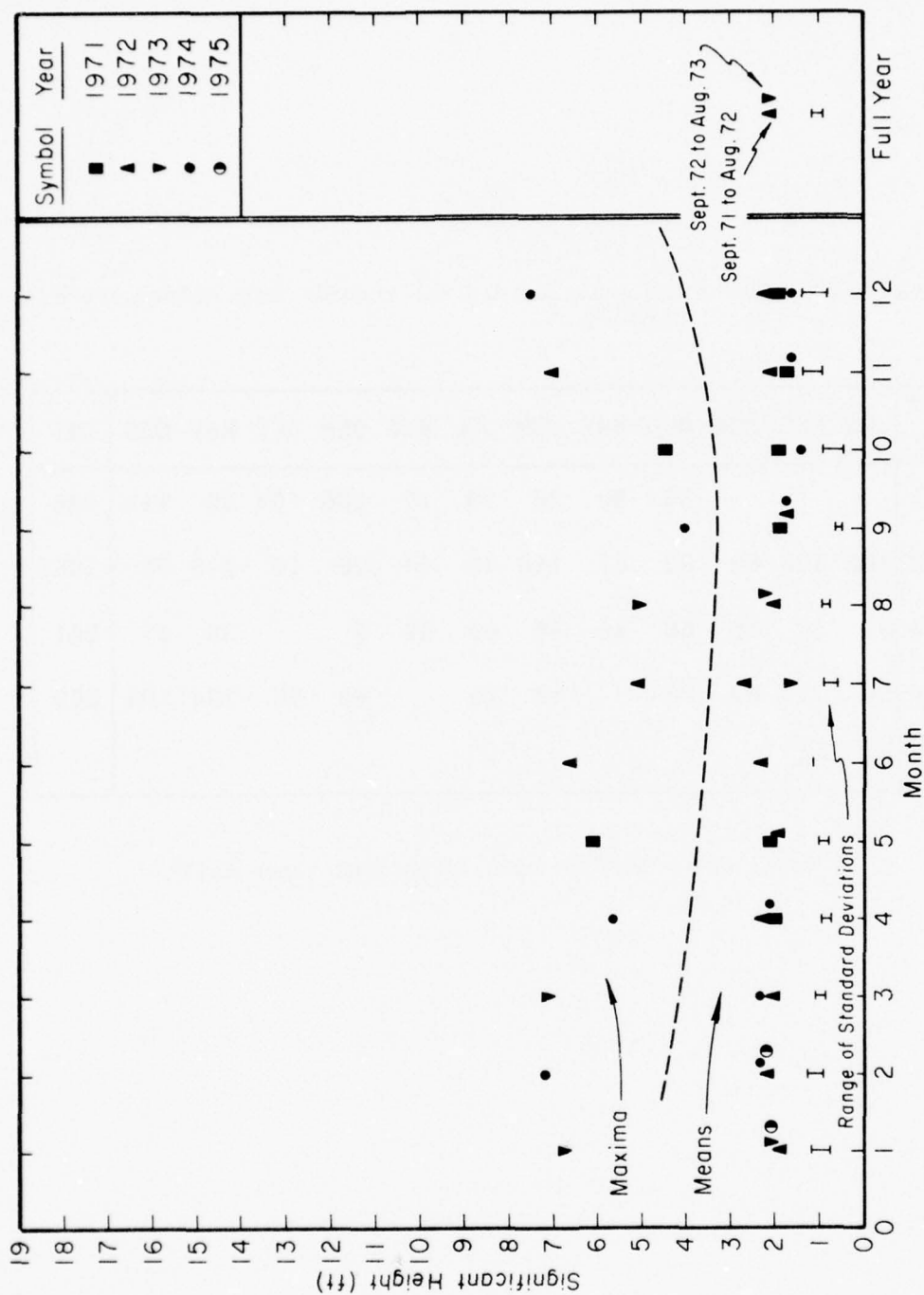


Figure A-38. Maxima, means, and standard deviations of significant height from Holden Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

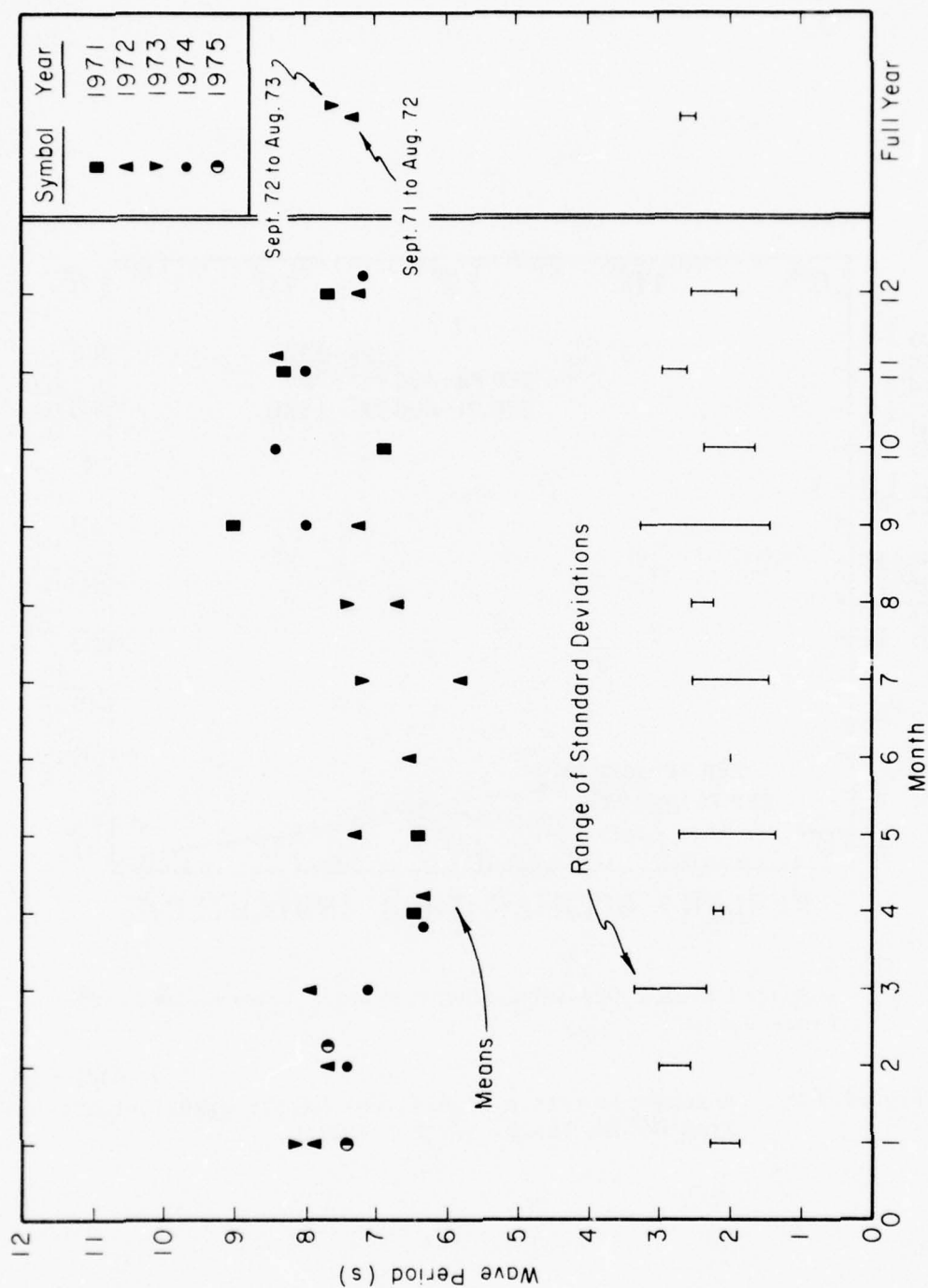
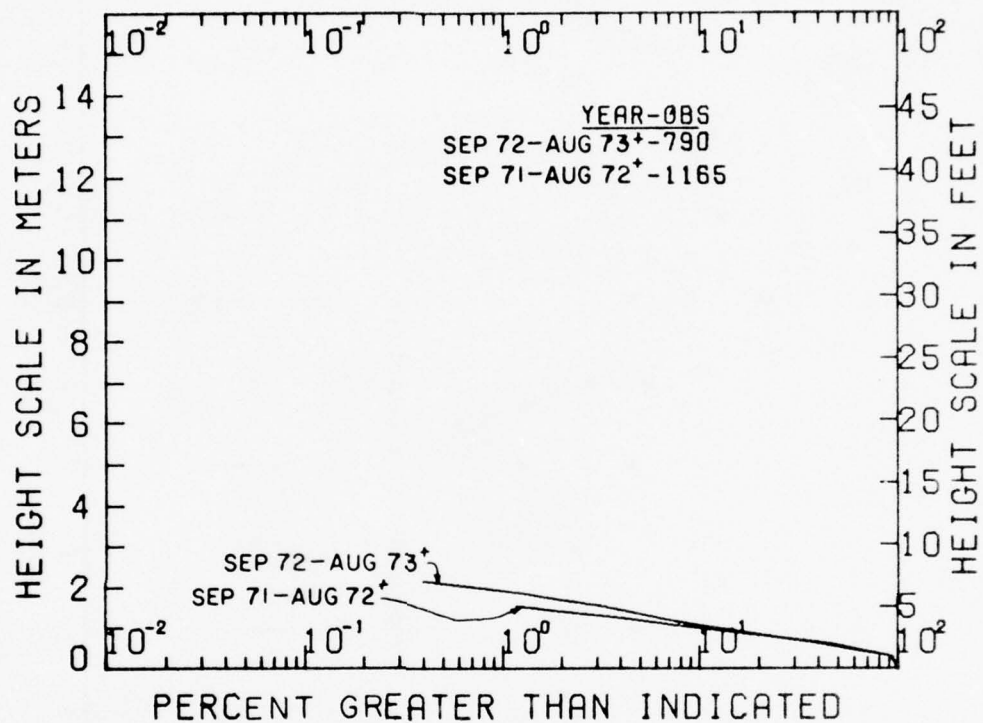


Figure A-39. Means and standard deviations of wave periods for Holden Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Figure A-40. Annual cumulative significant height distributions from Holden Beach, North Carolina.

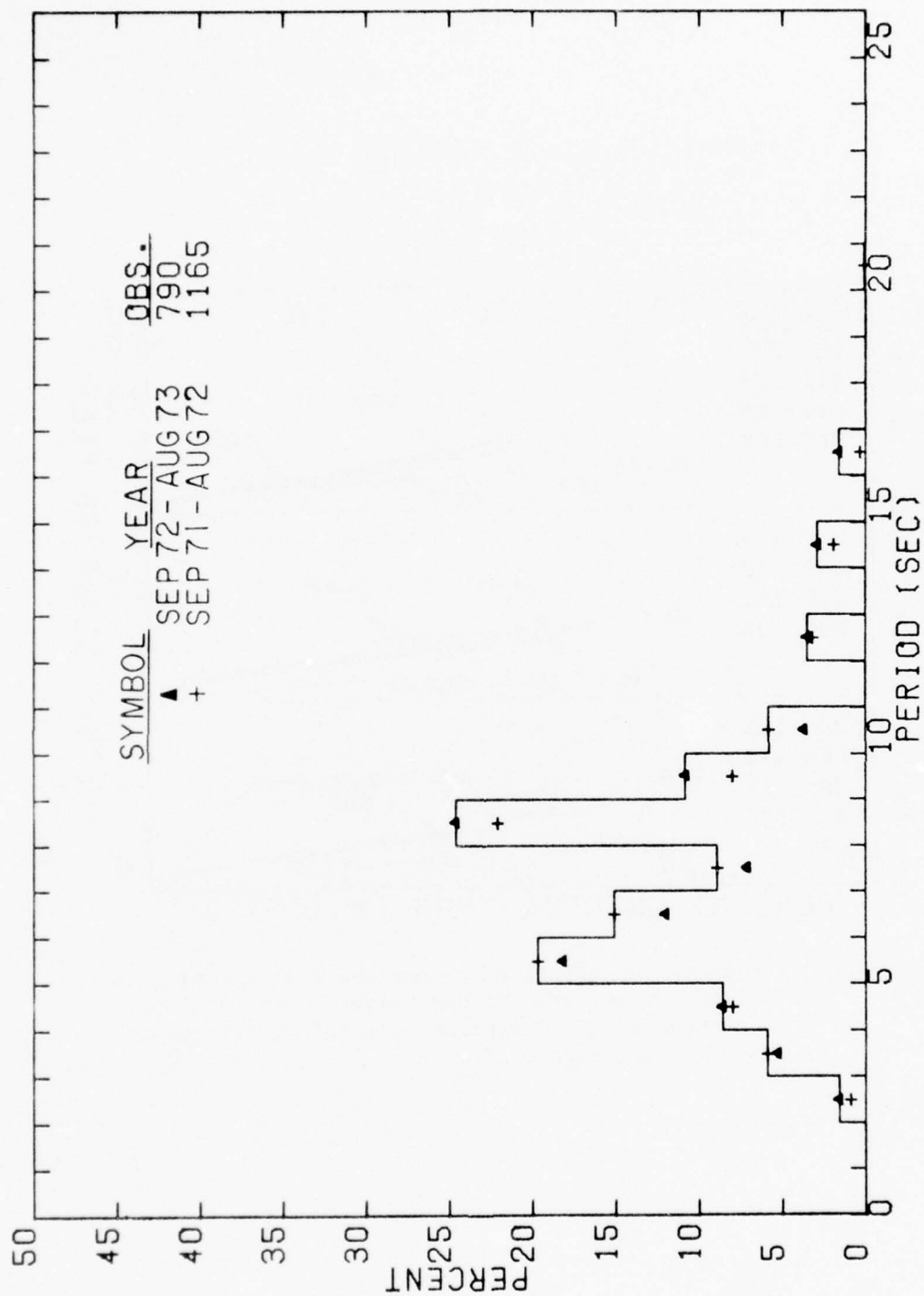


Figure A-41. Annual significant period distributions from Holden Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

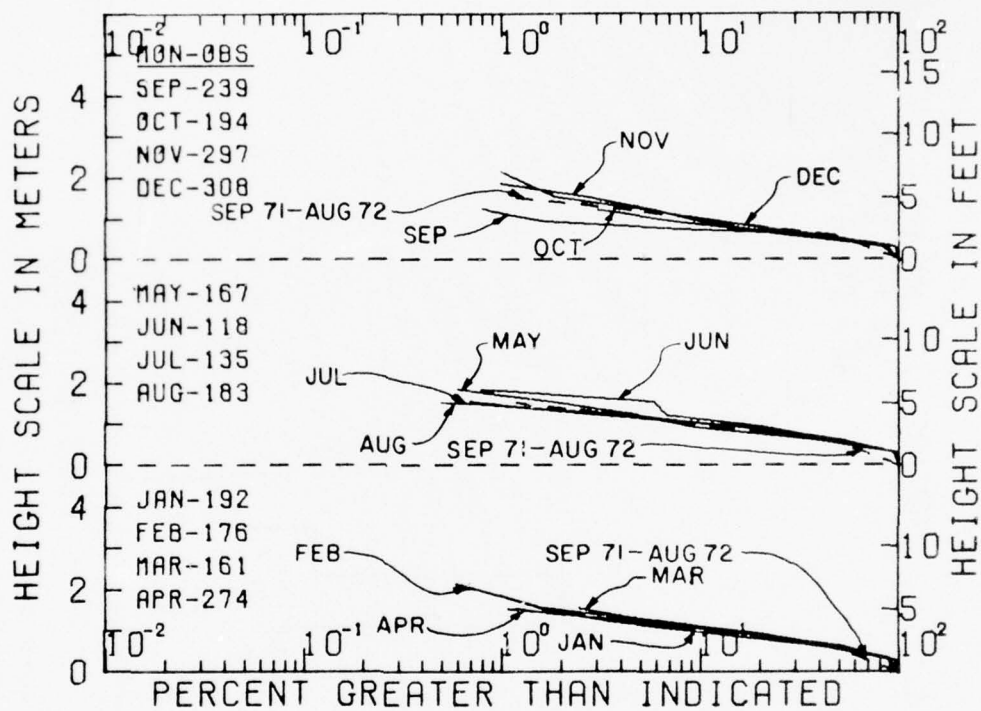


Figure A-42. Seasonal summaries of cumulative significant height distributions from Holden Beach, North Carolina; computed from 1,024-second digital wave records taken four times daily.

Table A-24. Wave climate for Holden Beach, North Carolina.
Distribution of significant height versus period
(in observations per 1,000 observations).

192 OBSERVATIONS										SUMMARY FOR JAN 72 JAN 73									
PERIOD (SECS)										SIG. HEIGHT (FT)									
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. HUR. TOT.* AVG.*										
0.0 = .9									1000 0.00										
1.0 = 1.9									1000 0.00										
2.0 = 2.9			5					5	1000 1.50										
3.0 = 3.9		26	10					36	945 1.79										
4.0 = 4.9			10					10	958 2.50										
5.0 = 5.9	5	68	47	21				141	948 2.09										
6.0 = 6.9	10	36	78	26				151	807 2.29										
7.0 = 7.9	10	21	52	16	5			104	656 2.35										
8.0 = 8.9	26	120	73	16	10	5		255	552 2.11										
9.0 = 9.9	16	78	26	5	5		5	135	297 1.96										
10.0 = 10.9	16	104	5					125	161 1.42										
11.0 = 11.9									36 0.00										
12.0 = 12.9		31						31	36 1.50										
13.0 = 13.9									5 0.00										
14.0 = 14.9		5						5	5 1.50										
TOTAL	85	495	302	83	21	5	10		2.02										
CUM. TOTAL	1000	917	422	120	36	16	10												
COL. AVG.	8.50*	8.47	7.16	7.00	8.50	8.50	9.00	7.96											
AVERAGE SIG. HEIGHT = 1.98 FT										AVERAGE WAVE PERIOD = 8.02 SEC*									
VARIANCE OF SIG. HEIGHT = .97 FT SQ										VARIANCE OF WAVE PERIOD = 4.33 SEC SQ*									
STANDARD DEVIATION OF HEIGHT = .98 FT										STANDARD DEVIATION OF PERIOD = 2.08 SEC*									
RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE																			
WAVE GAGE LOCATED AT HOLDEN BEACH PIKE,																			
* CALMS ARE OMITTED.																			

176 OBSERVATIONS										SUMMARY FOR FEB 72 FEB 74									
PERIOD (SECS)										SIG. HEIGHT (FT)									
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. HUR. TOT.* AVG.*									
0.0 = .9										1000 0.00									
1.0 = 1.9										1000 0.00									
2.0 = 2.9										1000 1.50									
3.0 = 3.9	6	28	34						68	972 1.92									
4.0 = 4.9		28	34	11					74	903 2.27									
5.0 = 5.9	6	28	74	62	11				162	830 2.75									
6.0 = 6.9		34	40	6	6				85	648 2.30									
7.0 = 7.9		40	17	23					80	562 2.29									
8.0 = 8.9		108	34	23	6	6			176	483 2.18									
9.0 = 9.9	6	80	34	11	23			6	159	307 2.46									
10.0 = 10.9	17	57	11	6		6			97	148 1.79									
11.0 = 11.9										51 0.00									
12.0 = 12.9	6	17							23	51 1.25									
13.0 = 13.9										28 0.00									
14.0 = 14.9	11	6	6						23	28 1.25									
15.0 = 15.9										6 0.00									
16.0 = 16.9						6			6	6 4.50									
TOTAL	51	455	284	142	51	11		6		2.25									
CUM. TOTAL	1000	949	494	210	68	17	6	6											
COL. AVG.	10.17*	7.79	6.62	6.78	8.94	9.50	0.00	9.50	7.52										
AVERAGE SIG. HEIGHT = 2.25 FT										AVERAGE WAVE PERIOD = 7.58 SEC*									
VARIANCE OF SIG. HEIGHT = 1.11 FT SQ										VARIANCE OF WAVE PERIOD = 7.30 SEC SQ*									
STANDARD DEVIATION OF HEIGHT = 1.05 FT										STANDARD DEVIATION OF PERIOD = 2.70 SEC*									

161 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 74

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, #	CUM, TOT, #	ROW, AVG, #
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9		12					12	1000	1.50
3.0 = 3.9	19	31	25				75	988	1.58
4.0 = 4.9		6	61	25	6		118	913	2.76
5.0 = 5.9		19	75	25	6		124	795	2.65
6.0 = 6.9		62	37	37	6	12	155	671	2.66
7.0 = 7.9		31	43	6	6		87	516	2.36
8.0 = 8.9	12	62	50	25	6		155	429	2.18
9.0 = 9.9	19	50	31	6		12	118	273	2.13
10.0 = 10.9	50	68					118	155	1.08
11.0 = 11.9								37	0.00
12.0 = 12.9	6	6	6				19	37	1.50
13.0 = 13.9								19	0.00
14.0 = 14.9		6	12				19	19	2.17
TOTAL	106	354	360	124	31	25			2.20
CUM, TOTAL	1000	894	540	180	56	25			
COL, AVG,	8.47*	7.69	6.67	6.50	6.50	8.00	7.35		

AVERAGE SIG, HEIGHT = 2.19 FT

VARIANCE OF SIG, HEIGHT = .96 FT SQ

STANDARD DEVIATION OF HEIGHT = .98 FT

AVERAGE WAVE PERIOD = 7.40 SEC*

VARIANCE OF WAVE PERIOD = 6.43 SEC SQ*

STANDARD DEVIATION OF PERIOD = 2.54 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
WAVE GAGE LOCATED AT HULDEN BEACH PIEN,

* CALMS ARE OMITTED.

274 OBSERVATIONS

SUMMARY FOR APR 71 APR 72 APR 74

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, #	CUM, TOT, #	ROW, AVG, #
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9		33					33	1000	1.50
3.0 = 3.9		58	66				124	967	2.03
4.0 = 4.9		26	73	18	11		128	843	2.61
5.0 = 5.9	4	66	77	40	11	7	204	715	2.55
6.0 = 6.9	11	62	33	22	15	4	146	511	2.35
7.0 = 7.9	7	40	15	15			77	365	1.98
8.0 = 8.9	15	117	29	26			186	288	1.85
9.0 = 9.9		36	15	7			58	102	2.00
10.0 = 10.9	4	22		4			29	44	1.63
11.0 = 11.9								15	0.00
12.0 = 12.9		15					15	15	1.50
TOTAL	40	474	307	131	36	11			2.18
CUM, TOTAL	1000	960	485	179	47	11			
COL, AVG,	7.68*	6.78	5.51	6.69	5.60	5.83	6.36		

AVERAGE SIG, HEIGHT = 2.14 FT

VARIANCE OF SIG, HEIGHT = .82 FT SQ

STANDARD DEVIATION OF HEIGHT = .91 FT

AVERAGE WAVE PERIOD = 6.38 SEC*

VARIANCE OF WAVE PERIOD = 4.72 SEC SQ*

STANDARD DEVIATION OF PERIOD = 2.17 SEC*

167 OBSERVATIONS

SUMMARY FOR MAY 71 MAY 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM.*	HC*	AVG.*
0.0 = 1.9									1000	0.00	
1.0 = 1.9									1000	0.00	
2.0 = 2.9		18	6					24	1000	1.75	
3.0 = 3.9		78	54					132	976	1.91	
4.0 = 4.9	6	12	12					30	844	1.70	
5.0 = 5.9	6	66	114	6				192	814	2.13	
6.0 = 6.9	6	54	24	12	12			108	623	2.22	
7.0 = 7.9		78	24	6				108	515	1.83	
8.0 = 8.9	6	210	48	24	18	12	6	323	407	2.19	
9.0 = 9.9	6	72						78	84	1.42	
10.0 = 10.9									6	0.00	
11.0 = 11.9									6	0.00	
12.0 = 12.9									6	0.00	
13.0 = 13.9									6	0.00	
14.0 = 14.9									6	0.00	
15.0 = 15.9									6	0.00	
16.0 = 16.9									6	0.00	
17.0 = 17.9									6	0.00	
18.0 = 18.9									6	0.00	
19.0 = 19.9									6	0.00	
20.0 = 20.9									6	2.50	
21.0 =										0.00	
TOTAL	30	587	287	48	30	12	6			2.02	
CUM. TOTAL	1000	970	383	96	48	18	6				
COL. AVG.	6.90*	7.04	6.08	7.50	7.70	8.50	8.50	6.83			

AVERAGE SIG. HEIGHT = 2.01 FT AVERAGE WAVE PERIOD = 6.88 SEC*
 VARIANCE OF SIG. HEIGHT = .80 FT SQ VARIANCE OF WAVE PERIOD = 4.75 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .89 FT STANDARD DEVIATION OF PERIOD = 2.18 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HOLDEN BEACH PIER,
 * CALMS ARE OMITTED.

118 OBSERVATIONS

SUMMARY FOR JUN 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM.*	HC*	AVG.*
0.0 = 1.9									1000	0.00	
1.0 = 1.9									1000	0.00	
2.0 = 2.9		8						8	1000	1.50	
3.0 = 3.9		76	8					85	992	1.60	
4.0 = 4.9		42	34	25				102	907	2.33	
5.0 = 5.9		76	144	76		8		305	805	2.58	
6.0 = 6.9		85	34	8	8	17		153	500	2.44	
7.0 = 7.9		42	17	8		8		76	347	2.39	
8.0 = 8.9	17	127	8	25		8	8	195	271	2.11	
9.0 = 9.9		34	8			8		51	76	2.33	
10.0 = 10.9				8				8	25	3.50	
11.0 = 11.9									17	0.00	
12.0 = 12.9		8						8	17	1.50	
13.0 = 13.9									8	0.00	
14.0 = 14.9		8						8	8	1.50	
TOTAL	17	508	254	153	8	51	8			2.31	
CUM. TOTAL	1000	983	475	220	68	59	8				
COL. AVG.	8.50*	6.88	5.80	6.28	6.50	7.33	8.50	6.47			

AVERAGE SIG. HEIGHT = 2.28 FT AVERAGE WAVE PERIOD = 6.51 SEC*
 VARIANCE OF SIG. HEIGHT = 1.29 FT SQ VARIANCE OF WAVE PERIOD = 3.94 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.13 FT STANDARD DEVIATION OF PERIOD = 1.99 SEC*

167 OBSERVATIONS

SUMMARY FOR MAY 71 MAY 72

PERIOD (SECS)	SIG. HEIGHT (FT)							CUM. TOT. #	HUM. AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT. #	
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9		18	6					24	1000 1.75
3.0 = 3.9		78	54					132	976 1.91
4.0 = 4.9	6	12	12					30	844 1.70
5.0 = 5.9	6	66	114	6				192	814 2.15
6.0 = 6.9	6	54	24	12	12			108	623 2.22
7.0 = 7.9	6	78	24	6				108	515 1.85
8.0 = 8.9	6	210	48	24	18	12	6	323	407 2.19
9.0 = 9.9	6	72						78	64 1.42
10.0 = 10.9									6 0.00
11.0 = 11.9									6 0.00
12.0 = 12.9									6 0.00
13.0 = 13.9									6 0.00
14.0 = 14.9									6 0.00
15.0 = 15.9									6 0.00
16.0 = 16.9									6 0.00
17.0 = 17.9									6 0.00
18.0 = 18.9									6 0.00
19.0 = 19.9									6 0.00
20.0 = 20.9			6					6	6 2.50
21.0 =									0.00
TOTAL	30	587	287	48	30	12	6		2.02
CUM. TOTAL	1000	970	385	96	48	18	6		
COL. AVG.	6.90*	7.04	6.08	7.50	7.70	8.50	8.50	6.83	

AVERAGE SIG. HEIGHT = 2.01 FT AVERAGE WAVE PERIOD = 6.88 SEC*
 VARIANCE OF SIG. HEIGHT = .80 FT SQ VARIANCE OF WAVE PERIOD = 4.75 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .89 FT STANDARD DEVIATION OF PERIOD = 2.18 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HOLDEN BEACH PIER,
 * CALMS ARE OMITTED.

118 OBSERVATIONS

SUMMARY FOR JUN 72

PERIOD (SECS)	SIG. HEIGHT (FT)							CUM. TOT. #	HUM. AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT. #	
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9		8						8	1000 1.50
3.0 = 3.9		76	8					85	992 1.60
4.0 = 4.9		42	34	25				102	907 2.33
5.0 = 5.9		76	144	76		8		305	805 2.58
6.0 = 6.9		65	34	8	8	17		153	500 2.44
7.0 = 7.9		42	17	8		8		76	347 2.39
8.0 = 8.9	17	127	8	25		8	8	195	271 2.11
9.0 = 9.9		34	8			8		51	76 2.35
10.0 = 10.9				8				8	25 3.50
11.0 = 11.9									17 0.00
12.0 = 12.9		8						8	17 1.50
13.0 = 13.9									8 0.00
14.0 = 14.9		8						8	8 1.50
TOTAL	17	508	254	153	8	51	8		2.31
CUM. TOTAL	1000	985	475	220	68	59	8		
COL. AVG.	6.50*	6.68	5.80	6.28	6.50	7.35	8.50	6.47	

AVERAGE SIG. HEIGHT = 2.28 FT AVERAGE WAVE PERIOD = 6.51 SEC*
 VARIANCE OF SIG. HEIGHT = 1.29 FT SQ VARIANCE OF WAVE PERIOD = 3.94 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.15 FT STANDARD DEVIATION OF PERIOD = 1.99 SEC*

135 OBSERVATIONS

SUMMARY FOR JUL 72 JUL 73

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM, H0=	TOT, *	AVG, *
0.0 = .9								1000	0.00	
1.0 = 1.9								1000	0.00	
2.0 = 2.9		7					7	1000	1.50	
3.0 = 3.9		30	44				74	993	2.10	
4.0 = 4.9		22	96	44			163	919	2.64	
5.0 = 5.9	30	74	96	74	15	7	296	756	2.48	
6.0 = 6.9	7	59	22	44	7		141	454	2.34	
7.0 = 7.9		52	30				81	319	1.86	
8.0 = 8.9	7	111	15				133	237	1.56	
9.0 = 9.9	7	52	15				74	104	1.60	
10.0 = 10.9								30	0.00	
11.0 = 11.9								30	0.00	
12.0 = 12.9		15					15	30	1.50	
13.0 = 13.9								15	0.00	
14.0 = 14.9		15					15	15	1.50	
TOTAL	52	437	319	163	22	7				2.19
CUM, TOTAL	1000	948	511	193	30	7				
COL, AVG,	6.04	7.42	5.50	5.50	5.83	5.50	6.40			

AVERAGE SIG, HEIGHT = 2.20 FT AVERAGE WAVE PERIOD = 6.42 SEC*
 VARIANCE OF SIG, HEIGHT = .78 FT SQ VARIANCE OF WAVE PERIOD = 4.45 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .89 FT STANDARD DEVIATION OF PERIOD = 2.11 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HULDEN BEACH PIER,
 * CALMS ARE OMITTED.

183 OBSERVATIONS

SUMMARY FOR AUG 72 AUG 73

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM, H0=	TOT, *	AVG, *
0.0 = .9								1000	0.00	
1.0 = 1.9								1000	0.00	
2.0 = 2.9		5					5	1000	1.50	
3.0 = 3.9		27	22	5			55	995	2.10	
4.0 = 4.9		22	60	33	5		120	940	2.68	
5.0 = 5.9		55	115	49	22		240	820	2.66	
6.0 = 6.9		49	22	27	5	5	109	579	2.55	
7.0 = 7.9		49	11	5			66	470	1.83	
8.0 = 8.9		262	27		5		295	404	1.65	
9.0 = 9.9		55					55	109	1.50	
10.0 = 10.9		22					22	55	1.50	
11.0 = 11.9								33	0.00	
12.0 = 12.9		11					11	33	1.50	
13.0 = 13.9								22	0.00	
14.0 = 14.9								22	0.00	
15.0 = 15.9								22	0.00	
16.0 = 16.9		22					22	22	1.50	
TOTAL		579	257	120	38	5				2.13
CUM, TOTAL	1000	1000	421	164	44	5				
COL, AVG,	0.00	6.07	5.59	5.65	5.93	6.50	7.02			

AVERAGE SIG, HEIGHT = 2.10 FT AVERAGE WAVE PERIOD = 7.04 SEC*
 VARIANCE OF SIG, HEIGHT = .71 FT SQ VARIANCE OF WAVE PERIOD = 5.81 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .85 FT STANDARD DEVIATION OF PERIOD = 2.41 SEC*

239 OBSERVATIONS

SUMMARY FOR SEP 71 SEP 72 SEP 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	HU=
0.0 = .9							1000	0.00
1.0 = 1.9							1000	0.00
2.0 = 2.9		4	8			13	1000	2.17
3.0 = 3.9	4	29	25			59	987	1.86
4.0 = 4.9		13	42	4		59	929	2.36
5.0 = 5.9		42	63	4	4	113	870	2.24
6.0 = 6.9		54	25		4	84	757	1.95
7.0 = 7.9		38	21			59	674	1.86
8.0 = 8.9	17	197	50			264	615	1.63
9.0 = 9.9	13	100	29			142	351	1.62
10.0 = 10.9	8	42	29			79	269	1.76
11.0 = 11.9							130	0.00
12.0 = 12.9		54	38			92	130	1.91
13.0 = 13.9							38	0.00
14.0 = 14.9		21	17			38	38	1.94
TOTAL	42	594	347	8	8			1.85
CUM. TOTAL	1000	958	364	17	8			
COL. AVG.	8.70*	8.56	7.74	5.00	6.00	6.23		

AVERAGE SIG. HEIGHT = 1.77 FT AVERAGE WAVE PERIOD = 8.24 SEC*
 VARIANCE OF SIG. HEIGHT = .27 FT SQ VARIANCE OF WAVE PERIOD = 7.37 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .52 FT STANDARD DEVIATION OF PERIOD = 2.72 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HOLDEN BEACH PIER,
 * CALMS ARE OMITTED.

194 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	HU=
0.0 = .9							1000	0.00
1.0 = 1.9							1000	0.00
2.0 = 2.9		21				21	1000	1.50
3.0 = 3.9		21				21	979	1.50
4.0 = 4.9		21	26			46	959	2.06
5.0 = 5.9	26	57	36	15		134	912	1.81
6.0 = 6.9	26	119	46		15	206	778	1.83
7.0 = 7.9	10	46	21	10		88	572	1.85
8.0 = 8.9	36	180	62	10	10	299	485	1.76
9.0 = 9.9	15	57	5	10	5	93	186	1.78
10.0 = 10.9		36	10			46	93	1.72
11.0 = 11.9							46	0.00
12.0 = 12.9	15	15				31	46	1.00
13.0 = 13.9							15	0.00
14.0 = 14.9		15				15	15	1.50
TOTAL	129	588	206	46	31			1.76
CUM. TOTAL	1000	871	284	77	31			
COL. AVG.	8.02*	7.68	7.05	7.50	7.67	7.59		

AVERAGE SIG. HEIGHT = 1.65 FT AVERAGE WAVE PERIOD = 7.58 SEC*
 VARIANCE OF SIG. HEIGHT = .57 FT SQ VARIANCE OF WAVE PERIOD = 4.78 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .76 FT STANDARD DEVIATION OF PERIOD = 2.19 SEC*

297 OBSERVATIONS

SUMMARY FOR NOV 71 NOV 72 NOV 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	HUW. AVG.*
0.0 - .9									1000	0.00
1.0 - 1.9									1000	0.00
2.0 - 2.9			3					3	1000	1.50
3.0 - 3.9		10	20					30	997	2.17
4.0 - 4.9		13	50	3				47	966	2.24
5.0 - 5.9	7	71	51	24	17	3		172	919	2.40
6.0 - 6.9	7	77	13	7	7			111	747	1.86
7.0 - 7.9	7	61	3			3		74	636	1.64
8.0 - 8.9	77	158	30	10	3	7	7	293	562	1.65
9.0 - 9.9	17	54		3	3			77	269	1.50
10.0 - 10.9	3	44				3	3	54	192	2.00
11.0 - 11.9									138	0.00
12.0 - 12.9	7	61						67	138	1.40
13.0 - 13.9									71	0.00
14.0 - 14.9	3	57						61	71	1.44
15.0 - 15.9									10	0.00
16.0 - 16.9	3	3						7	10	1.00
17.0 - 17.9									3	0.00
18.0 - 18.9									3	0.00
19.0 - 19.9									3	0.00
20.0 - 20.9			3					3	3	1.50
21.0 +										0.00
TOTAL	131	616	148	47	30	17	10			1.82
CUM. TOTAL	1000	869	253	104	57	27	10			
COL. AVG.	8.94*	8.89	5.77	6.50	6.50	8.10	9.17	8.24		

AVERAGE SIG. HEIGHT = 1.80 FT

AVERAGE WAVE PERIOD = 8.22 SEC*

VARIANCE OF SIG. HEIGHT = 1.18 FT SQ

VARIANCE OF WAVE PERIOD = 7.76 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.09 FT

STANDARD DEVIATION OF PERIOD = 2.79 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT HOLDEN BEACH PIER,

* CALMS ARE OMITTED.

308 OBSERVATIONS

SUMMARY FOR DEC 71 DEC 72 DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	HUW. AVG.*
0.0 - .9	26									1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9	6	3							10	1000	.83
3.0 - 3.9	6	13	13						31	990	1.70
4.0 - 4.9	6	42	32						83	957	1.82
5.0 - 5.9	36	75	52	6					173	873	1.67
6.0 - 6.9	32	52	49	42	3				183	700	2.12
7.0 - 7.9	3	26	23	10					63	517	2.13
8.0 - 8.9	23	120	45	19	19	6		3	243	453	2.20
9.0 - 9.9	26	71	10		3			6	120	210	1.78
10.0 - 10.9	3	29	13	3	6	3			60	90	2.33
11.0 - 11.9										30	0.00
12.0 - 12.9	10	10							20	30	1.00
13.0 - 13.9										10	0.00
14.0 - 14.9	6	3							10	10	.83
TOTAL	185	445	237	81	32	10		10			1.91
CUM. TOTAL	1000	815	370	133	52	19	10	10			
COL. AVG.	7.48*	7.56	6.66	7.18	8.80	9.17	0.00	9.17	7.37		

AVERAGE SIG. HEIGHT = 1.89 FT

AVERAGE WAVE PERIOD = 7.40 SEC*

VARIANCE OF SIG. HEIGHT = 1.29 FT SQ

VARIANCE OF WAVE PERIOD = 4.69 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.14 FT

STANDARD DEVIATION OF PERIOD = 2.16 SEC*

2444 OBSERVATIONS

SUMMARY FOR 27 MONTHS APR 71 THROUGH DEC 74

PERIOD (SECS)	SIG. HEIGHT (FT)								TOT.*	CUM. TOT.*	HON. AVG.*
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8			
0.0 - .9	3									1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9	1	12	1						14	1000	1.53
3.0 - 3.9	3	33	27						63	986	1.90
4.0 - 4.9	1	21	43	11	2				79	922	2.40
5.0 - 5.9	11	59	73	29	7	2			182	844	2.34
6.0 - 6.9	10	62	35	19	7	2			136	662	2.20
7.0 - 7.9	4	43	22	8	1	1			78	525	2.01
8.0 - 8.9	23	149	41	15	7	4	2		241	447	1.90
9.0 - 9.9	11	63	14	4	3	1		1	98	206	1.85
10.0 - 10.9	8	37	7	2	1	1			55	108	1.71
11.0 - 11.9										53	0.00
12.0 - 12.9	4	23	4						31	53	1.50
13.0 - 13.9										22	0.00
14.0 - 14.9	2	13	3						18	22	1.55
15.0 - 15.9										4	0.00
16.0 - 16.9		2							3	4	1.79
17.0 - 17.9										1	0.00
18.0 - 18.9										1	0.00
19.0 - 19.9										1	0.00
20.0 - 20.9									1	1	2.00
21.0 -											0.00
TOTAL	81	516	269	89	29	11	3	2			2.02
CUM. TOTAL	1000	919	403	134	45	16	5	2			
COL. AVG.	8.24*	7.85	6.42	6.52	7.20	7.79	6.93	9.25	7.36		

AVERAGE SIG. HEIGHT = 1.99 FT AVERAGE WAVE PERIOD = 7.38 SEC*
 VARIANCE OF SIG. HEIGHT = .94 FT SQ VARIANCE OF WAVE PERIOD = 6.07 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .97 FT STANDARD DEVIATION OF PERIOD = 2.46 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HULDEN BEACH PIER.

* CALMS ARE OMITTED.

Table A-25. CERC wave gage history for Savannah Coast Guard Light Tower, Savannah, Georgia.

CERC Form 174-74

18 Mar 74

COORDINATES: 31° 57' N., 80° 41' W.

LOCATION: Savannah Coast Guard Light Tower, Savannah, Georgia

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Continuous-wire staff	8 Apr. 1971	5 Dec. 1971	Power off.	35	-15 to +20	52	On east side of tower	Tower is 9 nmi from shore
	17 Feb. 1972	20 Oct. 1972	Gage broken loose.					
	14 Jan. 1973	30 July 1973	Gage broken loose.					
	28 Aug. 1973	8 Oct. 1973	Antenna cable damaged by vandals.					
	19 Nov. 1973	10 June 1974	Gage broken loose.					
	17 July 1974	9 Aug. 1974	Amplifier damaged.					
	8 Jan. 1975	31 Jan. 1975	Gage discontinued.					

Table A-26. Number of analyzed digital records from Savannah Light Tower, Georgia.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1971				76	104	89	83	124	117	119	86		798
1972			109	108	121	112	71	82	107	65			775
1973	52	89	108	41	68	70	65	16	82	29	31	40	691
1974	97	100	82	62	96	18	32						487

¹From 1,024-second records taken four times daily.

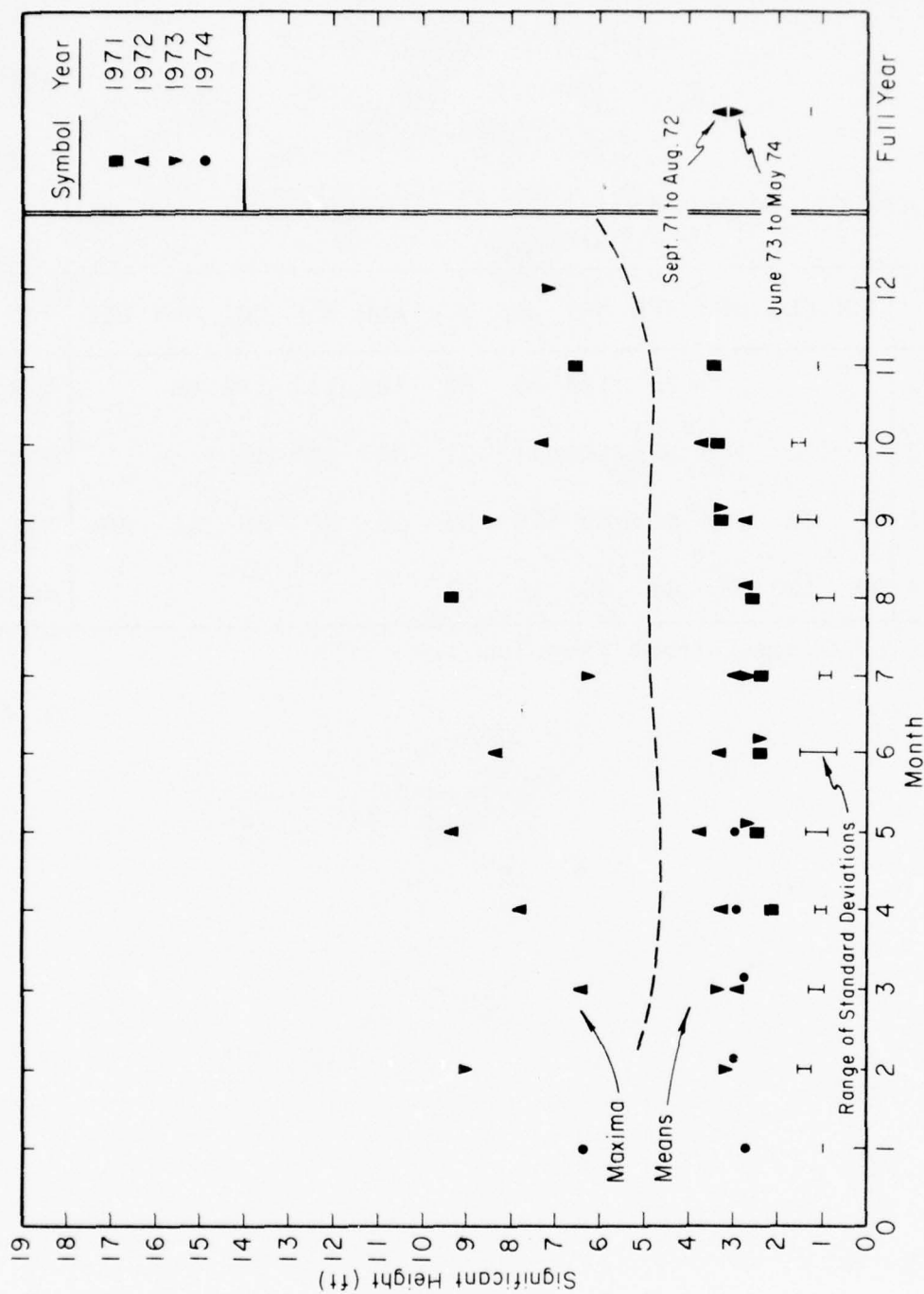


Figure A-43. Maxima, means, and standard deviations of significant height from Savannah Light Tower, Georgia; computed from 1,024-second digital wave records taken four times daily.

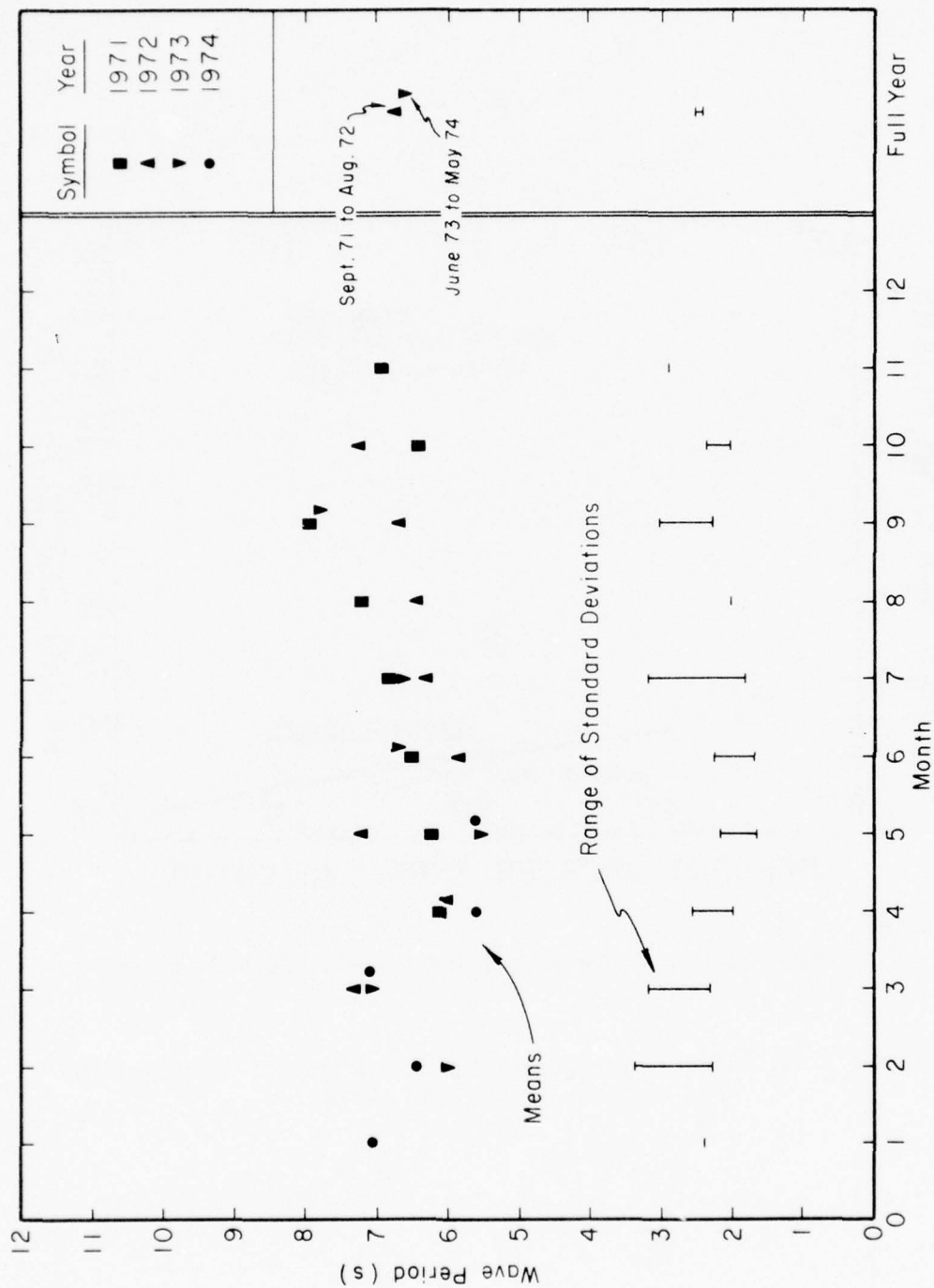
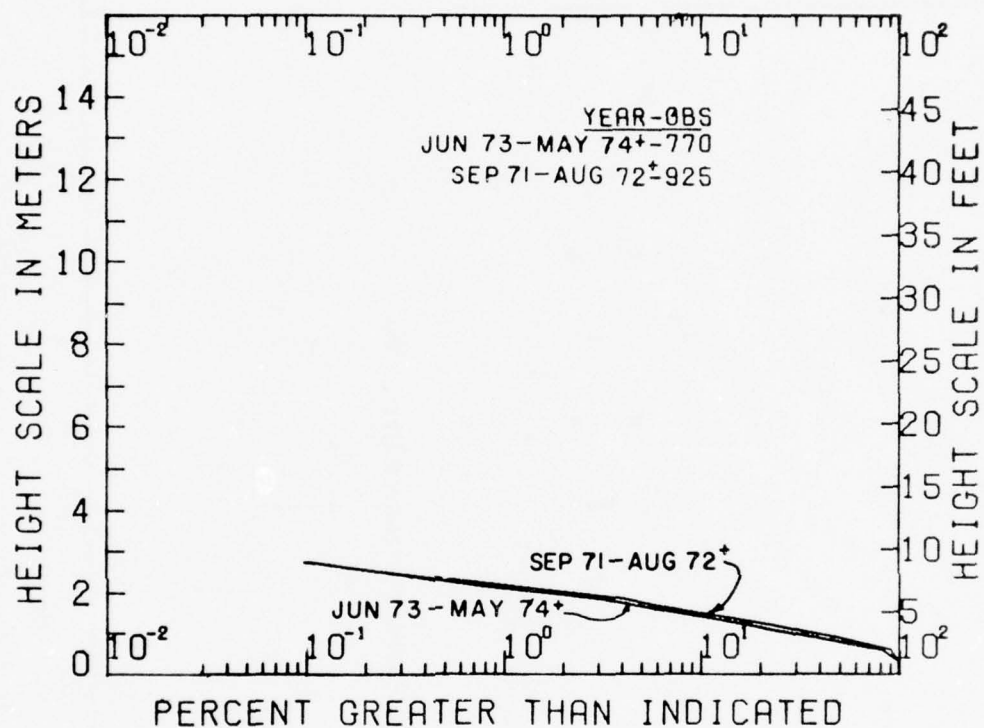


Figure A-44. Means and Standard deviations of wave periods for Savannah Light Tower, Georgia; computed from 1,024-second digital wave records taken four times daily.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Figure A-45. Annual cumulative significant height distributions from Savannah Light Tower, Georgia.

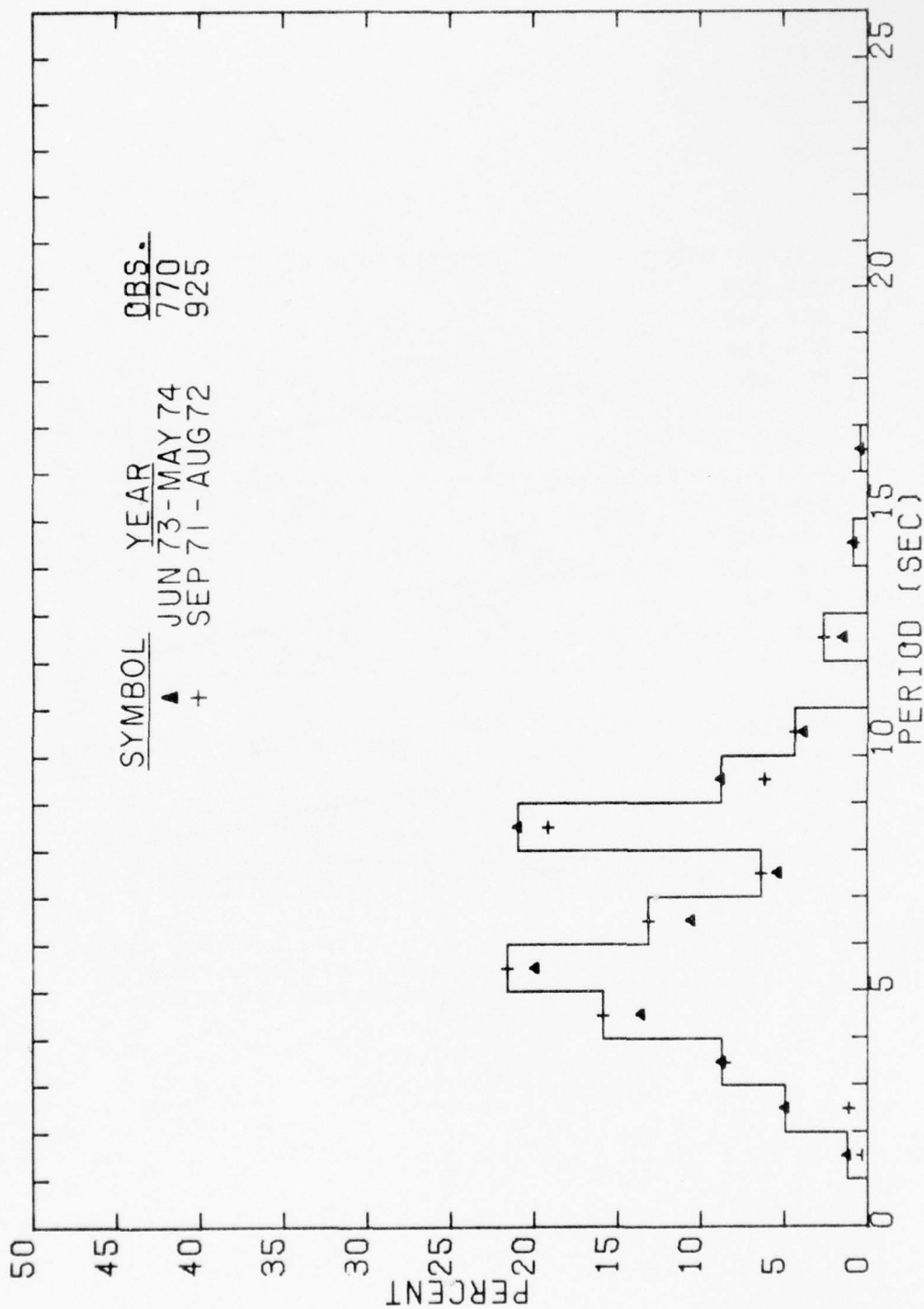


Figure A-46. Annual significant period distributions from Savannah Light Tower, Georgia; computed from 1,024-second digital wave records taken four times daily.

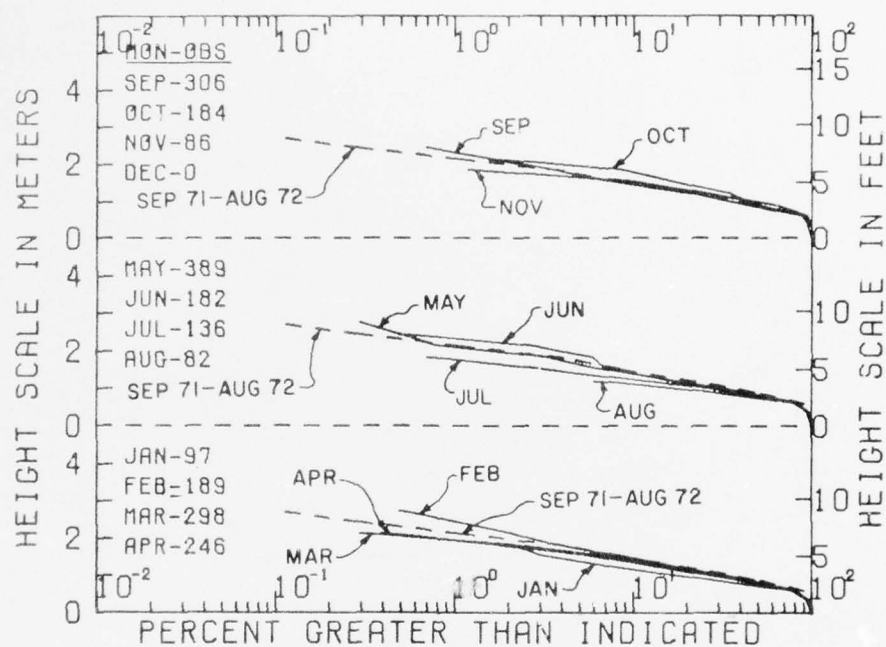


Figure A-47. Seasonal summaries of cumulative significant height distributions from Savannah Light Tower, Georgia; computed from 1,024-second digital wave records taken four times daily.

Table A-27. Wave climate for Savannah, Georgia.
Distribution of significant height versus period
(in observations per 1,000 observations).

97 OBSERVATIONS		SUMMARY FOR JAN 74									
PERIOD (SECS)	SIG. HEIGHT (FT)										
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*	
0.0 = .9									1000	0.00	
1.0 = 1.9		10	10					21	1000	2.00	
2.0 = 2.9		21	62					82	979	2.25	
3.0 = 3.9			10					10	897	2.50	
4.0 = 4.9		21	21	10				72	887	2.93	
5.0 = 5.9			41	62				165	814	3.94	
6.0 = 6.9		31	52	52				134	649	2.65	
7.0 = 7.9			41	10				52	515	2.70	
8.0 = 8.9		52	144	31				227	464	2.41	
9.0 = 9.9		62	124	10				196	237	2.24	
10.0 = 10.9		21	21					41	41	2.00	
TOTAL		216	926	175	52	10	21			2.68	
CUM. TOTAL	1000	1000	784	258	82	31	21				
COL. AVG.	0.00*	7.40	7.21	6.62	5.10	5.50	5.50	6.98			

AVERAGE SIG. HEIGHT = 2.70 FT	AVERAGE WAVE PERIOD = 7.07 SEC*
VARIANCE OF SIG. HEIGHT = .98 FT SQ	VARIANCE OF WAVE PERIOD = 5.80 SEC SQ*
STANDARD DEVIATION OF HEIGHT = .99 FT	STANDARD DEVIATION OF PERIOD = 2.41 SEC*

RESULTS OBTAINED FROM 1024*SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.
 * CALMS ARE OMITTED.

189 OBSERVATIONS		SUMMARY FOR FEB 73 FEB 74													
PERIOD (SECS)	SIG, HEIGHT (FT)												CUM. TOT, #	ROW TOT, #	AVG, #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT, #				
0.0 = .9													1000	0.00	
1.0 = 1.9			5								5	1000	2.50		
2.0 = 2.9		21	37								58	995	2.14		
3.0 = 3.9	5	48	138	42							235	937	2.43		
4.0 = 4.9			37	53	16	5					111	704	3.40		
5.0 = 5.9			21	53	42	26		5			148	593	4.14		
6.0 = 6.9		5	11	48	32	5	5	11			116	444	4.18		
7.0 = 7.9			11	21		5					37	328	3.50		
8.0 = 8.9			37	42	5	11	5			5	111	241	3.07		
9.0 = 9.9			53	42							95	180	1.94		
10.0 = 10.9			16	11	16		5				48	85	2.94		
11.0 = 11.9												37	0.00		
12.0 = 12.9				11							11	37	2.50		
13.0 = 13.9												26	0.00		
14.0 = 14.9			5		5						11	26	2.50		
15.0 = 15.9												10	0.00		
16.0 = 16.9			5								10	16	2.83		
TOTAL	5	190	370	243	106	48	16	16		5					
CUM. TOTAL	1000	995	804	434	190	85	37	21	5	5					
COL. AVG.	3.50	7.36	5.69	5.89	6.50	6.05	8.50	6.17	0.00	8.50	6.21		3.08		

AVERAGE SIG, HEIGHT = 3.06 FT
VARIANCE OF SIG, HEIGHT = 1.88 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.37 FT

AVERAGE WAVE PERIOD = 6.25 SEC
VARIANCE OF WAVE PERIOD = 8.62 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.94 SEC

297 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 73 MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT. #	CUM. TOT. #	ROW AVG. #
0.0 = .9									1000	0.00
1.0 = 1.9		7	3					10	1000	1.83
2.0 = 2.9		3	7					10	990	2.17
3.0 = 3.9		3	27	37	3			71	980	3.07
4.0 = 4.9		17	57	44	17	3	3	141	909	3.10
5.0 = 5.9		7	81	74	44	24	7	236	768	3.57
6.0 = 6.9		3	10	10	17	10		51	532	3.90
7.0 = 7.9		7	13	13	10	3	3	51	481	3.50
8.0 = 8.9		67	118	13	7	3	3	212	431	2.42
9.0 = 9.9	3	34	57	10				104	219	2.21
10.0 = 10.9		20	30	13				64	114	2.39
11.0 = 11.9									51	0.00
12.0 = 12.9			17	10				27	51	2.86
13.0 = 13.9									24	0.00
14.0 = 14.9			3	13	3	3		24	24	3.79
TOTAL	3	168	424	239	101	47	17			2.97
CUM. TOTAL	1000	997	828	404	165	64	17			
COL. AVG.	9.50	7.84	7.33	6.58	6.13	6.64	6.30	7.07		

AVERAGE SIG. HEIGHT = 2.98 FT AVERAGE WAVE PERIOD = 7.09 SEC*
 VARIANCE OF SIG. HEIGHT = 1.19 FT SQ VARIANCE OF WAVE PERIOD = 6.88 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.09 FT STANDARD DEVIATION OF PERIOD = 2.62 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS XIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.
 * CALMS ARE OMITTED.

246 OBSERVATIONS

SUMMARY FOR APR 71 APR 72 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT. #	CUM. TOT. #	ROW AVG. #
0.0 = .9										1000	0.00
1.0 = 1.9				4					4	1000	3.50
2.0 = 2.9	8	33	8	4					53	996	1.65
3.0 = 3.9		20	73	16	8				118	943	2.60
4.0 = 4.9		41	81	65	20				207	825	2.81
5.0 = 5.9	4	65	73	41	37	8			228	618	3.77
6.0 = 6.9	8	20	20	28	12	4	4	4	98	390	3.04
7.0 = 7.9		12	28	4	4				53	293	2.73
8.0 = 8.9	4	65	69	20	4				163	240	2.23
9.0 = 9.9		16	16						33	77	2.00
10.0 = 10.9		4	20	4					28	45	2.50
11.0 = 11.9										16	0.00
12.0 = 12.9			8	4					12	16	2.83
13.0 = 13.9										4	0.00
14.0 = 14.9			4						4	4	2.50
TOTAL	24	211	394	224	89	41	12	4			2.83
CUM. TOTAL	1000	976	764	170	146	37	16	4			
COL. AVG.	5.33	6.19	6.24	5.59	5.45	5.70	5.83	6.50	5.97		

AVERAGE SIG. HEIGHT = 2.83 FT AVERAGE WAVE PERIOD = 5.95 SEC*
 VARIANCE OF SIG. HEIGHT = 1.36 FT SQ VARIANCE OF WAVE PERIOD = 4.96 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.16 FT STANDARD DEVIATION OF PERIOD = 2.23 SEC*

389 OBSERVATIONS

SUMMARY FOR MAY 71 MAY 72 MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9												1000	0.00	
1.0 = 1.9												1000	0.00	
2.0 = 2.9		21	8	3								31	1000	1.92
3.0 = 3.9		28	64	13								105	969	2.35
4.0 = 4.9		21	77	67	15	3	3					189	864	3.01
5.0 = 5.9		8	49	85	39	13	18	3	3			216	679	3.86
6.0 = 6.9		28	28	18	18	8	5			3		108	463	3.31
7.0 = 7.9		5	28	18	8	3						62	355	3.08
8.0 = 8.9		33	121	21	23	5						203	293	2.74
9.0 = 9.9		26	33	15								75	90	2.36
10.0 = 10.9			10	3	3							15	15	3.00
TOTAL		170	419	242	105	31	26	3	3	3				3.02
CUM. TOTAL	1000	1000	830	411	170	64	33	8	5	3				
COL. AVG.	0.00*	6.11	6.46	5.87	6.45	6.33	5.80	5.50	5.50	6.50	6.23			

AVERAGE SIG. HEIGHT = 3.01 FT AVERAGE WAVE PERIOD = 6.25 SEC*
 VARIANCE OF SIG. HEIGHT = 1.46 FT SQ VARIANCE OF WAVE PERIOD = 4.19 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.21 FT STANDARD DEVIATION OF PERIOD = 2.05 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER,
 * CALMS ARE OMITTED.

271 OBSERVATIONS

SUMMARY FOR JUN 71 JUN 72 JUN 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9											1000	0.00	
1.0 = 1.9			4	4							7	1000	3.00
2.0 = 2.9		4	11								15	993	2.25
3.0 = 3.9		15	81	22	4						122	978	2.62
4.0 = 4.9		7	92	59	22						181	856	3.03
5.0 = 5.9		7	100	41	26	4	15	4			196	675	3.39
6.0 = 6.9		22	41	26	7		7	7	4		114	480	3.44
7.0 = 7.9		22	33	4							59	365	2.19
8.0 = 8.9	4	133	64		18	4		4			229	306	2.18
9.0 = 9.9		30	37	7							74	77	2.20
10.0 = 10.9			4								4	4	1.50
TOTAL	4	244	465	162	77	7	22	15	4				2.77
CUM. TOTAL	1000	996	753	288	125	48	41	18	4				
COL. AVG.	8.50*	7.77	5.83	5.16	5.93	7.00	5.83	6.75	6.50	6.23			

AVERAGE SIG. HEIGHT = 2.75 FT AVERAGE WAVE PERIOD = 6.26 SEC*
 VARIANCE OF SIG. HEIGHT = 1.47 FT SQ VARIANCE OF WAVE PERIOD = 4.18 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.21 FT STANDARD DEVIATION OF PERIOD = 2.04 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER,
 * CALMS ARE OMITTED.

219 OBSERVATIONS

SUMMARY FOR JUL 71 JUL 72 JUL 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. ROW TOT.* AVG.*
0.0 = .9									1000 0.00
1.0 = 1.9	5							5	1000 1.50
2.0 = 2.9	5	14	5					23	995 1.50
3.0 = 3.9	5	14	55	37	5			114	973 2.70
4.0 = 4.9	5	44	87	50	18	5		210	854 2.72
5.0 = 5.9	5	5	41	64	27	9	5	155	648 3.47
6.0 = 6.9		14	37	23				73	493 2.63
7.0 = 7.9		14	32	9				59	420 2.35
8.0 = 8.9	5	68	142	27	9			251	361 2.37
9.0 = 9.9		9	18	9	5			41	110 2.72
10.0 = 10.9			5	9				14	64 3.17
11.0 = 11.9									55 0.00
12.0 = 12.9			9	14				23	55 3.10
13.0 = 13.9									32 0.00
14.0 = 14.9		14	14	5				32	32 2.21
TOTAL	27	201	443	247	64	14	5		2.68
CUM. TOTAL	1000	973	772	329	82	18	5		
COL. AVG.	4.33*	7.00	6.65	6.39	5.79	5.17	5.50	6.60	

AVERAGE SIG. HEIGHT = 2.66 FT AVERAGE WAVE PERIOD = 6.60 SEC*
 VARIANCE OF SIG. HEIGHT = .86 FT SQ VARIANCE OF WAVE PERIOD = 6.79 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .93 FT STANDARD DEVIATION OF PERIOD = 2.61 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.
 * CALMS ARE OMITTED.

206 OBSERVATIONS

SUMMARY FOR AUG 71 AUG 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. ROW TOT.* AVG.*
0.0 = .9									1000 0.00
1.0 = 1.9			5					5	1000 2.50
2.0 = 2.9									995 0.00
3.0 = 3.9		5	73	15				92	995 2.61
4.0 = 4.9		19	78	19	10	5		131	903 2.76
5.0 = 5.9		15	53	58	34	5	5	170	772 3.36
6.0 = 6.9		29	39	15	5			92	602 2.82
7.0 = 7.9		24	49	5				78	510 2.25
8.0 = 8.9		124	170	10				306	432 2.12
9.0 = 9.9		10	49	34				92	126 2.76
10.0 = 10.9			15	5	10			29	34 3.33
11.0 = 11.9									5 0.00
12.0 = 12.9								5	5 2.50
TOTAL		228	534	160	58	10	5		2.63
CUM. TOTAL	1000	1000	772	238	78	19	10		
COL. AVG.	0.00*	7.54	6.82	6.53	6.25	5.00	5.50	6.88	

AVERAGE SIG. HEIGHT = 2.63 FT AVERAGE WAVE PERIOD = 6.90 SEC*
 VARIANCE OF SIG. HEIGHT = .92 FT SQ VARIANCE OF WAVE PERIOD = 4.29 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .96 FT STANDARD DEVIATION OF PERIOD = 2.07 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.
 * CALMS ARE OMITTED.

306 OBSERVATIONS

SUMMARY FOR SEP 71 SEP 72 SEP 73

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT, #	CUM, TOT, #	ROW, AVG, #
0.0 = .9											1000	0.00
1.0 = 1.9		3	3							7	1000	2.00
2.0 = 2.9		3	3							7	993	2.00
3.0 = 3.9		7	52	10	3					72	987	2.64
4.0 = 4.9		10	39	49	16		3			116	915	3.22
5.0 = 5.9		10	39	49	52	26	3			180	797	3.81
6.0 = 6.9		16	23	26	20	16	10	7	7	124	618	4.18
7.0 = 7.9		10	13	7	3		3			36	493	2.95
8.0 = 8.9		33	98	33	23			3		190	458	2.83
9.0 = 9.9		26	75	7	3					111	268	2.38
10.0 = 10.9		3	46	7	3					59	157	2.67
11.0 = 11.9											98	0.00
12.0 = 12.9		3	46	13	10					72	98	2.91
13.0 = 13.9											26	0.00
14.0 = 14.9				20	7					26	26	2.75
TOTAL		124	458	204	134	42	20	10	7			3.14
CUM, TOTAL	1000	1000	876	418	212	78	36	16	7			
COL, AVG,	0.00	7.37	8.13	6.85	6.77	5.88	6.17	7.17	6.50	7.43		

AVERAGE SIG, HEIGHT = 3.07 FT

AVERAGE WAVE PERIOD = 7.48 SEC

VARIANCE OF SIG, HEIGHT = 1.63 FT SQ

VARIANCE OF WAVE PERIOD = 7.56 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.27 FT

STANDARD DEVIATION OF PERIOD = 2.75 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.

* CALMS ARE OMITTED.

184 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 72

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT, #	CUM, TOT, #	ROW, AVG, #
0.0 = .9										1000	0.00
1.0 = 1.9				5					5	1000	3.50
2.0 = 2.9									5	995	2.50
3.0 = 3.9		5	43	16					65	989	2.67
4.0 = 4.9		5	92	43					141	924	2.77
5.0 = 5.9			11	33	98	54	22	5	223	783	4.77
6.0 = 6.9		5	38	16	65	33	38	5	201	560	4.48
7.0 = 7.9		5	5	5			11	5	33	359	4.67
8.0 = 8.9		33	125	11	11				179	326	2.50
9.0 = 9.9		5	38						43	147	2.38
10.0 = 10.9		22	71						92	103	2.26
11.0 = 11.9										11	0.00
12.0 = 12.9				5					5	11	2.50
13.0 = 13.9										5	0.00
14.0 = 14.9				5					5	5	2.50
TOTAL		82	440	130	174	87	71	16			3.52
CUM, TOTAL	1000	1000	918	478	348	174	87	16			
COL, AVG,	0.00	8.30	7.36	5.21	6.08	5.88	6.35	6.50	6.72		

AVERAGE SIG, HEIGHT = 3.46 FT

AVERAGE WAVE PERIOD = 6.69 SEC

VARIANCE OF SIG, HEIGHT = 2.28 FT SQ

VARIANCE OF WAVE PERIOD = 4.99 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.51 FT

STANDARD DEVIATION OF PERIOD = 2.23 SEC

86 OBSERVATIONS

SUMMARY FOR NOV 71

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9		12	12					23	1000	2.00
3.0 = 3.9		12	47	35				93	977	2.75
4.0 = 4.9			12	105				116	884	3.40
5.0 = 5.9			47	47	81	47		221	767	4.08
6.0 = 6.9			58	35	23	35	12	163	547	3.93
7.0 = 7.9			35	23	12			70	384	3.17
8.0 = 8.9		12	58	81	23	12		166	314	3.31
9.0 = 9.9			12					12	128	2.50
10.0 = 10.9		23	12	12				47	116	2.25
11.0 = 11.9									70	0.00
12.0 = 12.9			12	12				23	70	3.00
13.0 = 13.9									47	0.00
14.0 = 14.9					12			12	47	4.50
15.0 = 15.9									35	0.00
16.0 = 16.9				35				35	35	2.50
TOTAL		58	337	349	151	93	12			3.42
CUM. TOTAL	1000	1000	942	605	256	105	12			
COL. AVG.	0.00*	7.10	7.67	6.33	6.96	6.25	6.50	6.92		

AVERAGE SIG. HEIGHT = 3.43 FT

AVERAGE WAVE PERIOD = 6.89 SEC*

VARIANCE OF SIG. HEIGHT = 1.18 FT SQ

VARIANCE OF WAVE PERIOD = 6.50 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.09 FT

STANDARD DEVIATION OF PERIOD = 2.91 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.

* CALMS ARE OMITTED.

Insufficient data for December.

2490 OBSERVATIONS

SUMMARY FOR 27 MONTHS APR 71 THROUGH MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9												1000	0.00
1.0 = 1.9		2	2	1							6	1000	2.29
2.0 = 2.9	1	12	11	1							24	994	1.96
3.0 = 3.9	1	15	62	22	2						102	970	2.59
4.0 = 4.9		18	67	52	15		1				155	867	2.98
5.0 = 5.9	1	6	53	61	44	21	10	2			197	712	3.79
6.0 = 6.9	1	17	29	24	18	8	7	3	1	1	109	515	3.63
7.0 = 7.9		10	25	10	4	2	2				53	406	2.89
8.0 = 8.9	1	62	106	19	13	2	1	1			206	353	2.49
9.0 = 9.9		24	44	9	1						79	147	2.32
10.0 = 10.9		8	22	6	2						38	69	2.57
11.0 = 11.9												31	0.00
12.0 = 12.9			11	5	1						18	31	2.89
13.0 = 13.9												13	0.00
14.0 = 14.9		2	5	3	1						11	13	2.91
15.0 = 15.9												2	0.00
16.0 = 16.9			2								2	2	2.67
TOTAL	6	177	438	213	101	36	20	6	2	1			2.96
CUM. TOTAL	1000	994	817	380	166	65	29	9	3	1			
COL. AVG.	5.30*	7.17	6.84	6.11	6.24	6.07	6.15	6.57	6.25	7.17	6.63		

AVERAGE SIG. HEIGHT = 2.95 FT

AVERAGE WAVE PERIOD = 6.64 SEC*

VARIANCE OF SIG. HEIGHT = 1.46 FT SQ

VARIANCE OF WAVE PERIOD = 6.06 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.21 FT

STANDARD DEVIATION OF PERIOD = 2.46 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT SAVANNAH LIGHT TOWER.

* CALMS ARE OMITTED.

Table A-28. CERC wave gage history for Sunglow Fishing Pier, Daytona Beach, Florida.

CERC Form 174-74 18 Mar 74		LOCATION: Sunglow Fishing Pier, Daytona Beach, Florida					
COORDINATES: 29°09' N., 80°58' W.							
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Pier Length (feet)
Pressure	8 Nov. 1964	1 Aug. 1966	Gage struck by lightning.	—	-7 to +18 (mounted 7 ft below MSL)	11	1,000
	20 Oct. 1966	12 Dec. 1966	Gage struck by lightning.				
	21 Jan. 1967	21 July 1967	Gage struck by lightning.				
	19 Oct. 1967	13 June 1968	Gage struck by lightning.				
	1 Aug. 1968	17 Aug. 1968	Gage struck by lightning.				
	20 Oct. 1968	31 Aug. 1969	Gage damaged by storm.				
	10 Sept. 1969	21 July 1970	Gage struck by lightning.				
	29 July 1970	29 Aug. 1970	Gage damaged by storm.				
	22 Oct. 1970	5 July 1972	Electronic cable corroded.				
	11 Aug. 1972	25 July 1974	Gage discontinued.				

Table A-29. Number of analyzed records from Daytona Beach, Florida.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1964											129	175	304
1965	171	133	183	179	186	170	157	166	173	177	179	176	2050
1966	177	157	181	174	172	165	177	4		50	159		1416
1967	25	165	173	178	186	147	110			66	153	133	1336
1968	186	174	182	178	138								858
1969							120	110	81	62			373
1970													
1971			40	111	101	90	75	108	90	72	63	120	870
1972	103	112	120	110	118	112		76	106	115	100	77	1149
1973	98	90	114	60	98	97	52	67	55	80	80	59	950
1974	100	94	85	75	97	87	73						611

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the CERC method. Results after November 1968 obtained from 1,024-second digital records taken four times daily. Results for September 1971 to December 1972 have not been compensated for hydrodynamic attenuation due to submergence of the gage.

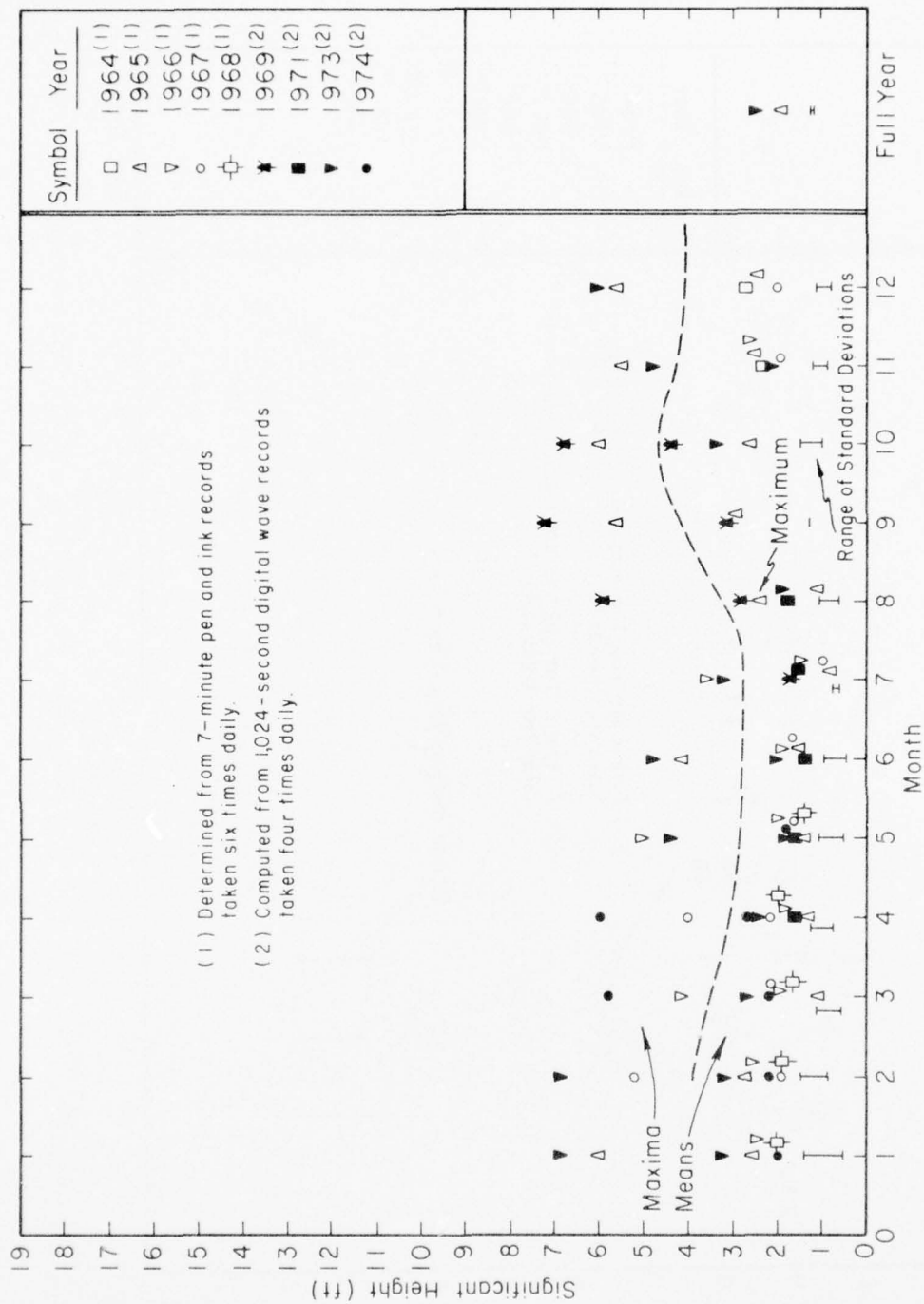


Figure A-48. Maxima, means, and standard deviations of significant height from Daytona Beach, Florida.

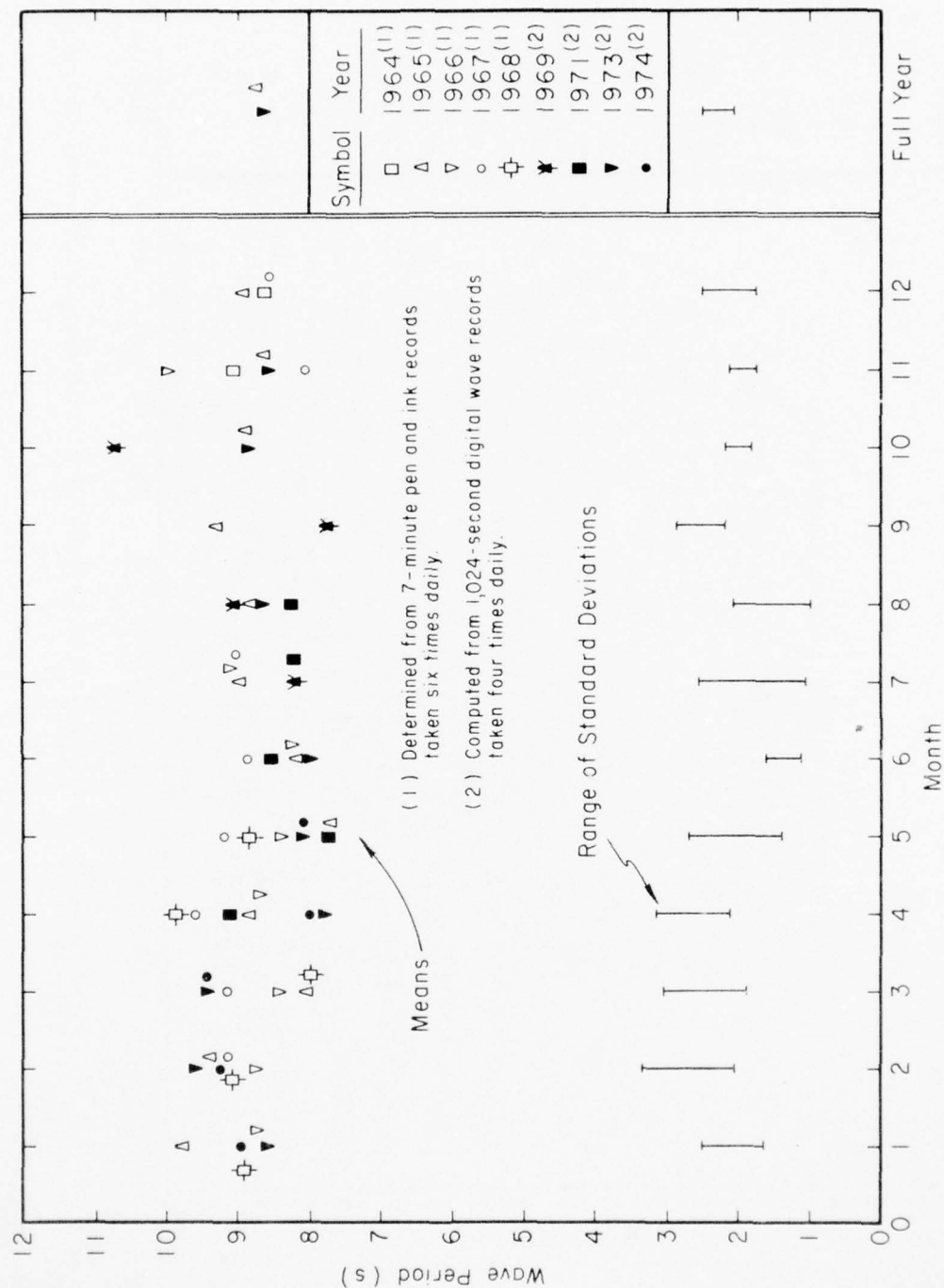
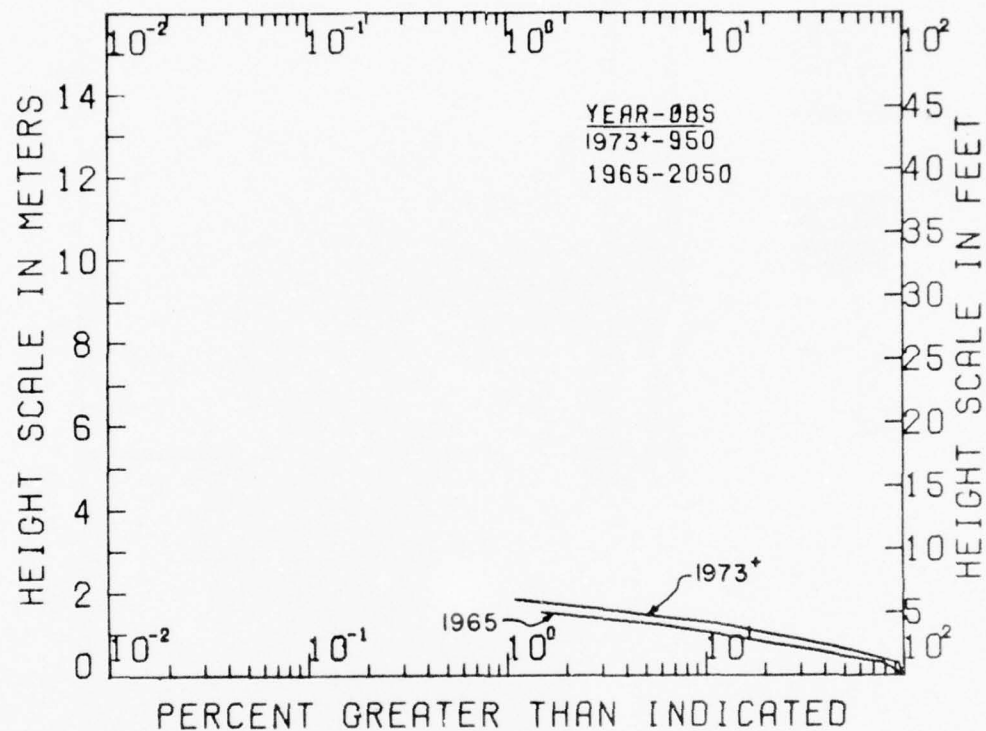


Figure A-49. Means and standard deviations of wave periods for Daytona Beach, Florida.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-50. Annual cumulative significant height distributions from Daytona Beach, Florida.

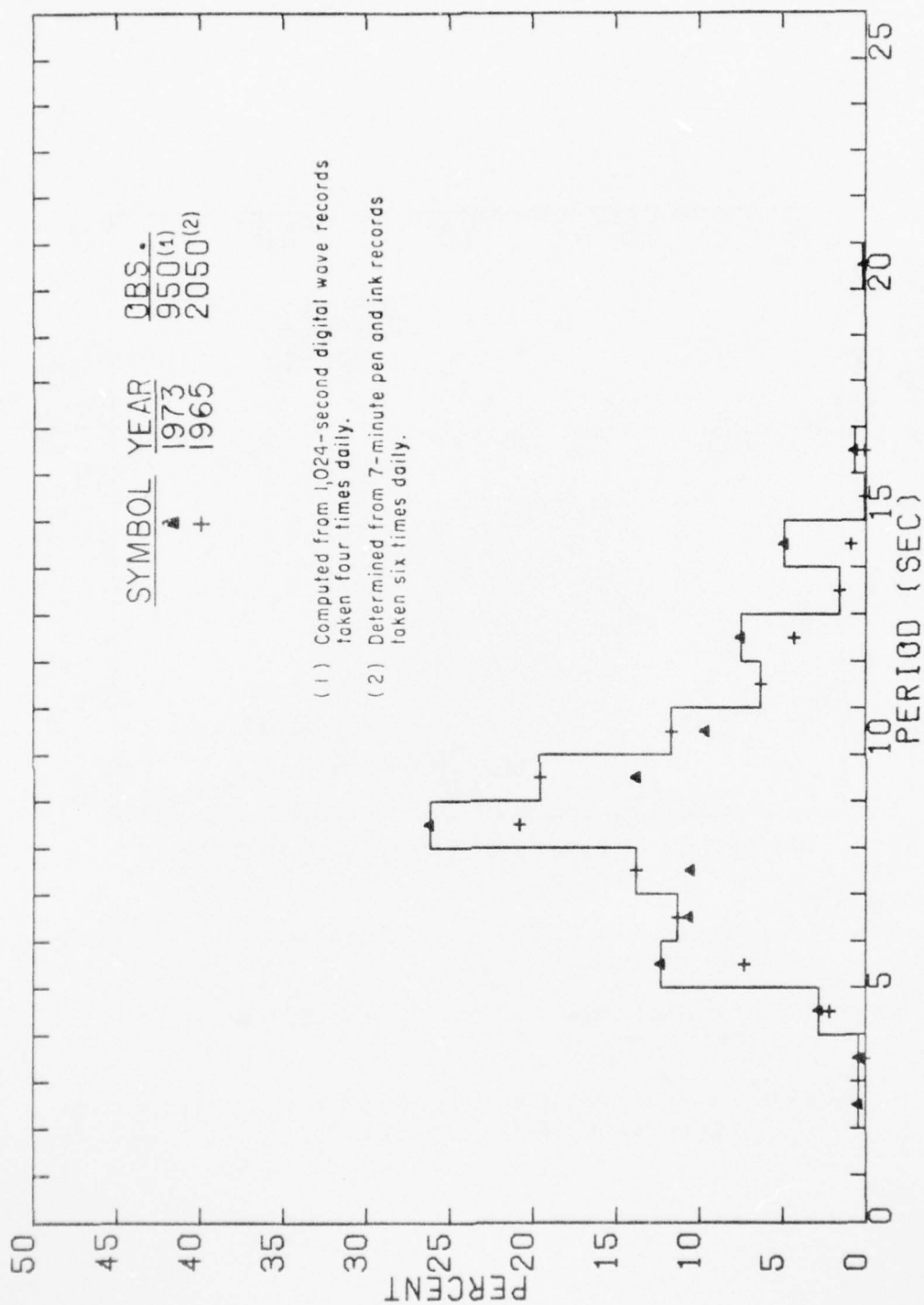


Figure A-51. Annual significant period distributions from Daytona Beach, Florida.

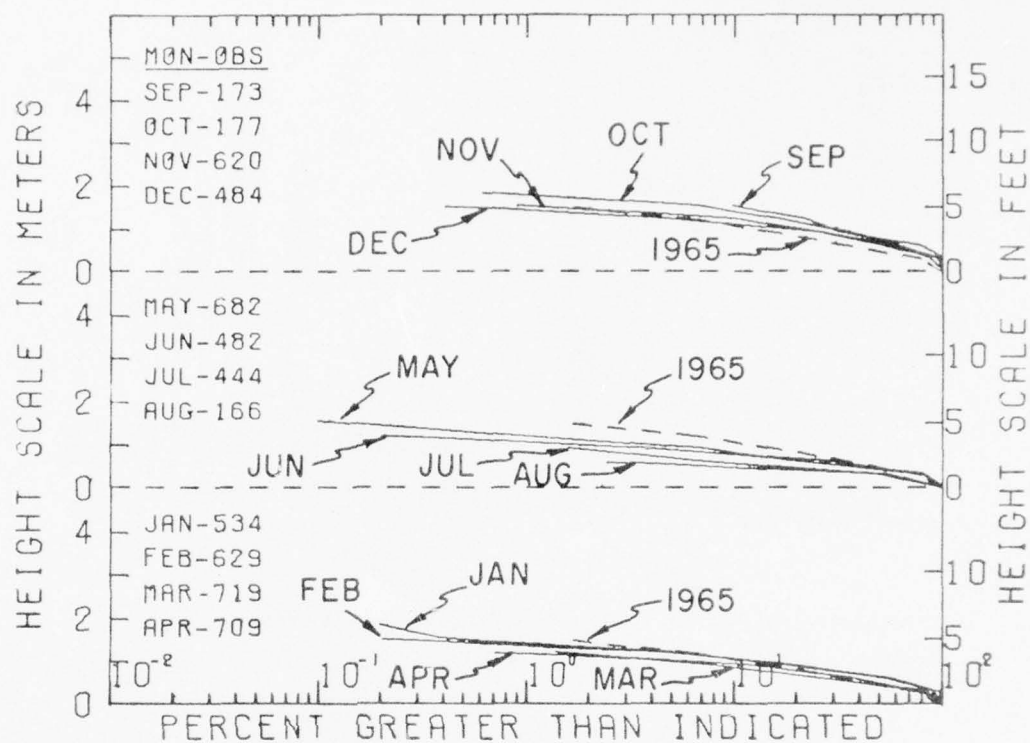


Figure A-52. Seasonal summaries of cumulative significant height distributions from Daytona Beach, Florida; determined from 7-minute pen and ink records taken six times daily.

AD-A037 904

COASTAL ENGINEERING RESEARCH CENTER FORT BELVOIR VA
WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS.(U)
JAN 77 E F THOMPSON
CERC-TR-77-1

F/G 8/3

UNCLASSIFIED

NL

3 OF 4
AD
A037904



Table A-30. Wave climate for Daytona Beach
Distribution of significant heights
(in observations per 1,000 of observations)

534 OBSERVATIONS		SUMMARY FOR JAN 65 JAN 66							
PERIOD (SECS)		HEIGHT (FT)							
		0=1	1=2	2=3	3=4	4=5	5=6	6=7	
1.0 - 1.9		7							
2.0 - 2.4									
2.5 - 2.9									
3.0 - 3.4									
3.5 - 3.9			2						
4.0 - 4.9			2	7	2				
5.0 - 5.9		2	30	22	2				
6.0 - 6.9			56	62	19	4			
7.0 - 7.9			32	58	28	9			
8.0 - 8.9		2	71	45	6	9			
9.0 - 9.9			86	51	21	6	2		
10.0 - 10.9		2	67	60	17	7			
11.0 - 11.9			41	41	15	4			
12.0 - 12.9		2	17	24	7	4		2	
13.0 - 13.9			7	19	6	2			
14.0 - 14.9			4	2	7				
TOTAL		15	416	391	129	45	2	2	
CUM. TOTAL		1000	985	569	178	49	4	2	
COL. AVG.		0.25*	0.03	0.06	0.46	0.38	0.50	12.50	
AVERAGE SIG. HEIGHT = 2.29 FT							AVERAGE WAVE P		
VARIANCE OF SIG. HEIGHT = .79 FT SQ							VARIANCE OF WA		
STANDARD DEVIATION OF HEIGHT = .89 FT							STANDARD DEVI		
RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN									
* WAVE GAGE LOCATED AT SUNGLON FISHING PIER									
* CALMS ARE OMITTED.									

429 OBSERVATIONS		SUMMARY FOR FEB 65 FEB 66						
PERIOD (SECS)		HEIGHT (FT)						
		0=1	1=2	2=3	3=4	4=5	5=6	TOT.*
1.0 - 1.9		13						
2.0 - 2.4								
2.5 - 2.9								
3.0 - 3.4								
3.5 - 3.9								
4.0 - 4.9		2	8					10
5.0 - 5.9		5	25	24	10			64
6.0 - 6.9		10	46	51	14	2		124
7.0 - 7.9		11	41	60	35	16		166
8.0 - 8.9		6	56	38	21	8		130
9.0 - 9.9		13	75	54	21	5		169
10.0 - 10.9		10	54	46	21	3		135
11.0 - 11.9		2	25	37	14	5		84
12.0 - 12.9			24	29	3	2	2	60
13.0 - 13.9			3	24	3	3		34
14.0 - 14.9		2	8	8	2			19
15.0 - 15.9			2					2
16.0 - 16.9			3					3
TOTAL		72	370	370	143	43	2	
CUM. TOTAL		1000	928	558	188	45	2	
COL. AVG.		0.42*	0.08	0.32	0.46	0.17	12.50	9.11
AVERAGE SIG. HEIGHT = 2.22 FT							AVERAGE WAVE P	
VARIANCE OF SIG. HEIGHT = .91 FT SQ							VARIANCE OF WA	
STANDARD DEVIATION OF HEIGHT = .95 FT							STANDARD DEVI	

719 OBSERVATIONS

SUMMARY FOR MAR 65 MAR 66 MAR 67 AR 68

PERIOD (SECS)	HEIGHT (FT)						CUM.	RD=
	0-1	1-2	2-3	3-4	4-5	TOT.*	TOT.*	AVG.*
.0 - 1.9	15						1000	.00
2.0 - 2.4							1000	.00
2.5 - 2.9							1000	.00
3.0 - 3.4							1000	.00
3.5 - 3.9							1000	.00
4.0 - 4.9	7	18				25	1000	1.22
5.0 - 5.9	19	96	8			126	975	1.41
6.0 - 6.9	15	82	35	19		154	849	1.89
7.0 - 7.9	14	85	31	8	1	141	695	1.77
8.0 - 8.9	26	75	19	6	4	133	554	1.63
9.0 - 9.9	31	114	19	10	1	178	421	1.57
10.0 - 10.9	13	81	31	10	4	140	243	1.86
11.0 - 11.9	13	31	17	1		62	103	1.61
12.0 - 12.9	6	7	7	6		25	41	2.00
13.0 - 13.9	1	1	6	1	3	13	16	2.72
14.0 - 14.9	1	1				3	3	1.00
TOTAL	161	591	172	61	14			1.68
CUM. TOTAL	1000	839	248	75	14			
COL. AVG.	8.50*	8.16	8.65	8.75	10.10	8.40		

AVERAGE SIG. HEIGHT = 1.68 FT AVERAGE WAVE PERIOD = 8.40 SEC*
 VARIANCE OF SIG. HEIGHT = .67 FT SQ VARIANCE OF WAVE PERIOD = 4.41 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .82 FT STANDARD DEVIATION OF PERIOD = 2.10 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT SUNGLOW FISHING PIER .
 * CALMS ARE OMITTED.

709 OBSERVATIONS

SUMMARY FOR APR 65 APR 66 APR 67 APR 68

PERIOD (SECS)	HEIGHT (FT)						CUM.	RD=
	0-1	1-2	2-3	3-4	4-5	TOT.*	TOT.*	AVG.*
.0 - 1.9	27						1000	.00
2.0 - 2.4							1000	.00
2.5 - 2.9							1000	.00
3.0 - 3.4	4					4	1000	.50
3.5 - 3.9	1					1	996	.50
4.0 - 4.9	10	10	1			22	994	1.10
5.0 - 5.9	17	30	20	3		71	972	1.62
6.0 - 6.9	13	51	42	16	1	126	901	2.03
7.0 - 7.9	8	32	51	21		116	775	2.25
8.0 - 8.9	24	56	21	24	4	133	659	1.95
9.0 - 9.9	30	63	24	8		129	526	1.59
10.0 - 10.9	35	72	31	6		148	397	1.55
11.0 - 11.9	16	59	16	6		99	249	1.62
12.0 - 12.9	17	23	13	6	1	61	151	1.69
13.0 - 13.9	6	20	30	8		65	90	2.14
14.0 - 14.9	1	6	3	10		20	25	2.57
15.0 - 15.9							4	.00
16.0 - 16.9				4		4	4	3.50
TOTAL	209	422	251	111	7			1.79
CUM. TOTAL	1000	791	370	118	7			
COL. AVG.	9.04*	9.32	9.09	9.70	8.90	9.25		

AVERAGE SIG. HEIGHT = 1.79 FT AVERAGE WAVE PERIOD = 9.25 SEC*
 VARIANCE OF SIG. HEIGHT = .89 FT SQ VARIANCE OF WAVE PERIOD = 6.42 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .94 FT STANDARD DEVIATION OF PERIOD = 2.53 SEC*

682 OBSERVATIONS

SUMMARY FOR MAY 65 MAY 66 MAY 67 MAY 68

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. ROW TOT.*	AVG.*
.0 = 1.9	75							1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9								1000	.00
4.0 = 4.9	16	18	3				40	1000	1.14
5.0 = 5.9	4	59	10				79	940	1.58
6.0 = 6.9	6	81	15	4			114	881	1.67
7.0 = 7.9	12	92	23	22	1		163	767	1.90
8.0 = 8.9	18	122	29	21	3		208	604	1.82
9.0 = 9.9	28	126	28	4	3		204	396	1.59
10.0 = 10.9	7	69	1	1			86	192	1.46
11.0 = 11.9	13	22	4	1			44	106	1.36
12.0 = 12.9	10	26	3	3		1	48	62	1.60
13.0 = 13.9		4	4	1			11	14	2.21
14.0 = 14.9				3			3	3	3.50
TOTAL	189	619	122	82	7	1			1.58
CUM. TOTAL	1000	811	192	70	9	1			
COL. AVG.	8.69*	8.43	8.36	8.79	8.70	12.50	8.49		

AVERAGE SIG. HEIGHT = 1.58 FT
 VARIANCE OF SIG. HEIGHT = .64 FT SQ
 STANDARD DEVIATION OF HEIGHT = .80 FT
 AVERAGE WAVE PERIOD = 8.49 SEC*
 VARIANCE OF WAVE PERIOD = 4.06 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.02 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT SUNGLON FISHING PIER
 * CALMS ARE OMITTED.

482 OBSERVATIONS

SUMMARY FOR JUN 65 JUN 66 JUN 67

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. ROW TOT.*	AVG.*
.0 = 1.9	35						1000	.00
2.0 = 2.4							1000	.00
2.5 = 2.9							1000	.00
3.0 = 3.4							1000	.00
3.5 = 3.9							1000	.00
4.0 = 4.9	4	6				11	1000	1.10
5.0 = 5.9	17	27				45	949	1.12
6.0 = 6.9	10	62	23			99	944	1.63
7.0 = 7.9	21	98	60	8		194	845	1.80
8.0 = 8.9	56	151	98	12	2	331	652	1.73
9.0 = 9.9	35	108	48	8		206	320	1.65
10.0 = 10.9	21	44	19			86	114	1.47
11.0 = 11.9	2	8		2		13	28	1.67
12.0 = 12.9	4	2	4	2		13	15	1.83
13.0 = 13.9							2	.00
14.0 = 14.9			2			2	2	2.50
TOTAL	205	506	253	33	2			1.62
CUM. TOTAL	1000	795	288	35	2			
COL. AVG.	8.45*	8.30	8.53	8.94	8.50	8.41		

AVERAGE SIG. HEIGHT = 1.62 FT
 VARIANCE OF SIG. HEIGHT = .60 FT SQ
 STANDARD DEVIATION OF HEIGHT = .77 FT
 AVERAGE WAVE PERIOD = 8.41 SEC*
 VARIANCE OF WAVE PERIOD = 2.11 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.45 SEC*

444 OBSERVATIONS

SUMMARY FOR JUL 65 JUL 66 JUL 67

PERIOD (SECS)	HEIGHT (FT)					CUM.	ROW
	0-1	1-2	2-3	3-4	TOT.*	TOT.*	AVG.*
.0 - 1.9	261					1000	.00
2.0 - 2.4						1000	.00
2.5 - 2.9						1000	.00
3.0 - 3.4						1000	.00
3.5 - 3.9						1000	.00
4.0 - 4.9	5	2			9	1000	.83
5.0 - 5.9	2	5			9	991	1.17
6.0 - 6.9	5	9	7		27	982	1.61
7.0 - 7.9	11	54	11	7	113	954	1.66
8.0 - 8.9	72	101	16	5	262	841	1.26
9.0 - 9.9	99	178	5	5	387	579	1.20
10.0 - 10.9	43	70	5		159	192	1.17
11.0 - 11.9	5	11	7		30	34	1.60
12.0 - 12.9		2			3	3	1.50
TOTAL	502	432	50	16			1.08
CUM. TOTAL	1000	498	65	16			
COL. AVG.	9.14*	9.11	8.68	8.36	9.08		

AVERAGE SIG. HEIGHT = 1.08 FT AVERAGE WAVE PERIOD = 9.08 SEC*
 VARIANCE OF SIG. HEIGHT = .44 FT SQ VARIANCE OF WAVE PERIOD = 1.46 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .66 FT STANDARD DEVIATION OF PERIOD = 1.21 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT SUNGLON FISHING PIER
 * CALMS ARE OMITTED.

166 OBSERVATIONS

SUMMARY FOR AUG 65

PERIOD (SECS)	HEIGHT (FT)				CUM.	ROW
	0-1	1-2	2-3	TOT.*	TOT.*	AVG.*
.0 - 1.9	331				1000	.00
2.0 - 2.4					1000	.00
2.5 - 2.9					1000	.00
3.0 - 3.4					1000	.00
3.5 - 3.9					1000	.00
4.0 - 4.9					1000	.00
5.0 - 5.9					1000	.00
6.0 - 6.9	6	18	6	45	1000	1.50
7.0 - 7.9	36	60	6	153	955	1.21
8.0 - 8.9	30	193	6	342	802	1.39
9.0 - 9.9	30	223		378	459	1.38
10.0 - 10.9	24	24		72	81	1.00
11.0 - 11.9			6	9	9	2.50
TOTAL	458	518	24			1.07
CUM. TOTAL	1000	542	24			
COL. AVG.	8.74*	8.84	8.50	8.81		

AVERAGE SIG. HEIGHT = 1.07 FT AVERAGE WAVE PERIOD = 8.81 SEC*
 VARIANCE OF SIG. HEIGHT = .29 FT SQ VARIANCE OF WAVE PERIOD = .99 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .54 FT STANDARD DEVIATION OF PERIOD = .99 SEC*

173 OBSERVATIONS

SUMMARY FOR SEP 65

PERIOD (SECS)	HEIGHT (FT)								
	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW AVG.*
.0 = 1.9								1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9								1000	.00
4.0 = 4.9								1000	.00
5.0 = 5.9		12	69	12			92	1000	2.50
6.0 = 6.9		29	52	6	6		92	908	2.37
7.0 = 7.9		35	35	6	12	6	92	815	2.62
8.0 = 8.9		58	35	17	12	6	127	723	2.50
9.0 = 9.9		40	110	23	23	23	220	595	2.95
10.0 = 10.9		29	64	6	23	17	139	376	3.04
11.0 = 11.9		23	58	12	17	23	133	237	3.20
12.0 = 12.9			12	23	6	17	58	104	4.00
13.0 = 13.9			12		17	6	35	46	4.00
14.0 = 14.9				6	6		12	12	4.00
TOTAL		225	445	110	121	98			2.92
CUM. TOTAL	1000	1000	775	329	220	98			
COL. AVG.	.00*	8.68	8.88	9.42	10.50	10.74	9.32		

AVERAGE SIG. HEIGHT = 2.92 FT AVERAGE WAVE PERIOD = 9.32 SEC*
 VARIANCE OF SIG. HEIGHT = 1.53 FT SQ VARIANCE OF WAVE PERIOD = 4.81 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.24 FT STANDARD DEVIATION OF PERIOD = 2.19 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
 WAVE GAGE LOCATED AT SUNGLOW FISHING PIER
 * CALMS ARE OMITTED.

177 OBSERVATIONS

SUMMARY FOR OCT 65

PERIOD (SECS)	HEIGHT (FT)									
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	ROW AVG.*
.0 = 1.9									1000	.00
2.0 = 2.4									1000	.00
2.5 = 2.9									1000	.00
3.0 = 3.4									1000	.00
3.5 = 3.9									1000	.00
4.0 = 4.9									1000	.00
5.0 = 5.9		11	23					34	994	2.17
6.0 = 6.9	6	6	45	90	11	17		175	960	3.34
7.0 = 7.9	11	17	40	11	23		6	107	745	2.87
8.0 = 8.9	51	158	28	11	17	11		277	678	1.85
9.0 = 9.9	51	34	40	17	6	11		158	401	2.04
10.0 = 10.9		11	28	28	17			85	243	3.10
11.0 = 11.9		6	17	11	6	11		51	158	3.06
12.0 = 12.9			34	11	17	6		68	107	3.42
13.0 = 13.9			11	17		6		34	40	3.50
14.0 = 14.9				6				6	6	2.50
TOTAL	124	240	254	198	96	62	6			2.59
CUM. TOTAL	1000	876	616	362	164	88	6			
COL. AVG.	8.86*	8.59	8.99	8.73	9.32	9.50	7.50	8.87		

AVERAGE SIG. HEIGHT = 2.59 FT AVERAGE WAVE PERIOD = 8.87 SEC*
 VARIANCE OF SIG. HEIGHT = 1.99 FT SQ VARIANCE OF WAVE PERIOD = 4.15 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.41 FT STANDARD DEVIATION OF PERIOD = 2.04 SEC*

620 OBSERVATIONS

SUMMARY FOR NOV 64 NOV 65 NOV 66 NOV 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	RD= AVG.*
1.0 = 1.9	5							1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9								1000	.00
4.0 = 4.9	3	2					5	1000	.83
5.0 = 5.9	2	47	16	5			70	995	1.85
6.0 = 6.9	2	58	37	13	11		122	925	2.29
7.0 = 7.9	2	37	45	24	18	2	128	804	2.69
8.0 = 8.9	6	79	34	32	21	2	175	676	2.43
9.0 = 9.9	11	94	61	37	15	3	222	501	2.32
10.0 = 10.9	6	55	35	23	16	2	138	279	2.44
11.0 = 11.9	6	32	21	10	5		75	141	2.15
12.0 = 12.9	3	10	13	3			29	66	2.06
13.0 = 13.9	5	3		5	3		16	37	2.40
14.0 = 14.9		8	3	2	3		16	21	2.50
15.0 = 15.9		2					2	5	1.50
16.0 = 16.9		2	2				3	3	2.00
TOTAL	52	427	268	153	92	8			2.33
CUM. TOTAL	1000	948	521	253	100	8			
COL. AVG.	9.74*	8.80	8.92	9.11	9.11	9.10	8.95		

AVERAGE SIG. HEIGHT = 2.33 FT

AVERAGE WAVE PERIOD = 8.95 SEC*

VARIANCE OF SIG. HEIGHT = 1.20 FT SQ

VARIANCE OF WAVE PERIOD = 4.30 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.09 FT

STANDARD DEVIATION OF PERIOD = 2.07 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE
WAVE GAGE LOCATED AT SUNGLOW FISHING PIER

* CALMS ARE OMITTED.

484 OBSERVATIONS

SUMMARY FOR DEC 64 DEC 65 DEC 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	RD= AVG.*
1.0 = 1.9								1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9								1000	.00
4.0 = 4.9			2	2			4	1000	3.00
5.0 = 5.9		23	43	6			72	996	2.27
6.0 = 6.9	2	74	45	52	2		176	924	2.37
7.0 = 7.9		68	35	48	12	4	167	748	2.60
8.0 = 8.9	2	54	54	19	21		149	581	2.51
9.0 = 9.9	2	83	37	33			155	432	2.15
10.0 = 10.9	4	48	48	25	6		130	277	2.36
11.0 = 11.9		39	14	10	2		66	147	2.12
12.0 = 12.9	2	21	29	4			56	81	2.13
13.0 = 13.9			10	4			14	25	2.79
14.0 = 14.9			2	6			8	10	3.25
15.0 = 15.9			2				2	2	2.50
TOTAL	12	409	322	209	43	4			2.37
CUM. TOTAL	1000	988	579	256	48	4			
COL. AVG.	9.67*	8.73	8.83	8.55	8.55	7.50	8.72		

AVERAGE SIG. HEIGHT = 2.37 FT

AVERAGE WAVE PERIOD = 8.72 SEC*

VARIANCE OF SIG. HEIGHT = .86 FT SQ

VARIANCE OF WAVE PERIOD = 4.46 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .93 FT

STANDARD DEVIATION OF PERIOD = 2.11 SEC*

5819 OBSERVATIONS

SUMMARY FOR 35 MONTHS NOV 64 THROUGH MAY 68

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - 1.9	29								1000	0.00	
2.0 - 2.9									1000	0.00	
3.0 - 3.9	1							1	1000	0.00	
4.0 - 4.9									999	1.00	
5.0 - 5.9	5	8	1					15	999	1.29	
6.0 - 6.9	7	38	17	3				69	984	1.74	
7.0 - 7.9	9	58	41	21	3	1		124	915	2.11	
8.0 - 8.9	21	88	36	16	8	1		180	791	2.21	
9.0 - 9.9	26	101	37	16	4	2		195	648	1.92	
10.0 - 10.9	15	59	31	11	5	1		128	467	1.83	
11.0 - 11.9	7	30	18	7	2	1		67	272	1.96	
12.0 - 12.9	5	14	14	5	1	1		42	166	2.06	
13.0 - 13.9	1	4	11	4	2			23	77	2.18	
14.0 - 14.9	1	3	2	3	1			10	35	2.56	
15.0 - 15.9								1	12	2.54	
16.0 - 16.9								1	2	1.83	
TOTAL	155	859	244	123	32	7		1	1	2.50	
CUM. TOTAL	1000	845	386	142	39	7				1.92	
COL. AVG.	8.83	8.71	8.94	9.13	9.30	10.05	10.00	8.85			

AVERAGE SIG. HEIGHT = 1.92 FT

AVERAGE WAVE PERIOD = 8.85 SEC

VARIANCE OF SIG. HEIGHT = 1.03 FT²VARIANCE OF WAVE PERIOD = 8.44 SEC²

STANDARD DEVIATION OF HEIGHT = 1.02 FT

STANDARD DEVIATION OF PERIOD = 2.11 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A PRESSURE

WAVE GAGE LOCATED AT SUNGLOW FISHING PIER

* CALMS ARE OMITTED.

1940 OBSERVATIONS

SUMMARY FOR 22 MONTHS JUL 69 THROUGH JUL 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9										1000	0.00	
1.0 - 1.9										1000	0.00	
2.0 - 2.9	3	18	14	16	12	1			63	1000	2.80	
3.0 - 3.9	1	5	2						7	937	1.65	
4.0 - 4.9	1	12	10	4	1				28	931	2.21	
5.0 - 5.9	3	20	46	26	7	3	1		106	903	2.75	
6.0 - 6.9	5	20	25	19	8	3	2		82	747	2.77	
7.0 - 7.9	4	24	23	13	4	2	1		71	715	2.46	
8.0 - 8.9	16	151	77	18	10	5	1		277	644	2.04	
9.0 - 9.9	11	76	46	8	8	4	1	1	154	367	2.13	
10.0 - 10.9	8	36	26	16	11	4	1		101	213	2.51	
11.0 - 11.9										112	0.00	
12.0 - 12.9	5	21	15	13	5	3			60	112	2.51	
13.0 - 13.9										52	0.00	
14.0 - 14.9	5	12	8	5	8	2	2		41	52	2.78	
15.0 - 15.9										10	0.00	
16.0 - 16.9	1	4	1	1	3		1		9	10	2.67	
17.0 - 17.9										1	0.00	
18.0 - 18.9										1	0.00	
19.0 - 19.9										1	0.00	
20.0 - 20.9										1	3.00	
21.0 -											0.00	
TOTAL	61	398	293	137	77	25	8	1			2.38	
CUM. TOTAL	1000	939	541	247	111	34	9	1				
COL. AVG.	9.14	8.60	8.04	7.66	8.63	9.06	9.38	9.50	8.36			

AVERAGE SIG. HEIGHT = 2.37 FT

AVERAGE WAVE PERIOD = 8.98 SEC

VARIANCE OF SIG. HEIGHT = 1.35 FT²VARIANCE OF WAVE PERIOD = 8.17 SEC²

STANDARD DEVIATION OF HEIGHT = 1.16 FT

STANDARD DEVIATION OF PERIOD = 2.86 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE

WAVE GAGE LOCATED AT SUNGLOW FISHING PIER.

* CALMS ARE OMITTED.

Table A-31. CERC wave gage history for Palm Beach Pier, Palm Beach, Florida.

CERC Form 174-74 18 Mar 74		LOCATION: Palm Beach Pier, Palm Beach, Florida						
COORDINATES: 26°42' N., 80°02' W.								
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance (SR), staff-parallel type	17 Feb. 1954	15 Oct. 1954	Recorder out of order.	25		16	0	800
	9 Dec. 1954	20 Oct. 1955						
SR staff-parallel type	22 Feb. 1956	9 Oct. 1956	Boat damaged pier, gage moved to side of pier.	25		16	0	800
	25 Feb. 1957	31 Mar. 1958	Gage damaged by storm.					
	30 June 1958	4 Mar. 1962	Gage destroyed by storm; not replaced.					

Table A-32. Number of analyzed pen and ink records from Palm Beach, Florida.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1954		72	159	168	162	173	178	180	169	49		120	1430
1955	177	139	177	169	175	174	180	181	172	43			1587
1956		44	181	179	160	160	175	179	174	102			1354
1957		13	92	147	83	172	124	152	159	186	174	108	1410
1958	119	147	5			5	170	178	57	175	123	182	1161
1959	183	162	181	176	148	161	181	170	171	154	168	165	2020
1960	116	174	174	170	142	93	67	184	155	184	157	71	1687
1961	36	79	104	136		34	101	177	168	179	180	107	1301
1962	150	112											262

¹From 7-minute records taken six times daily; analyzed by the second BEB method.

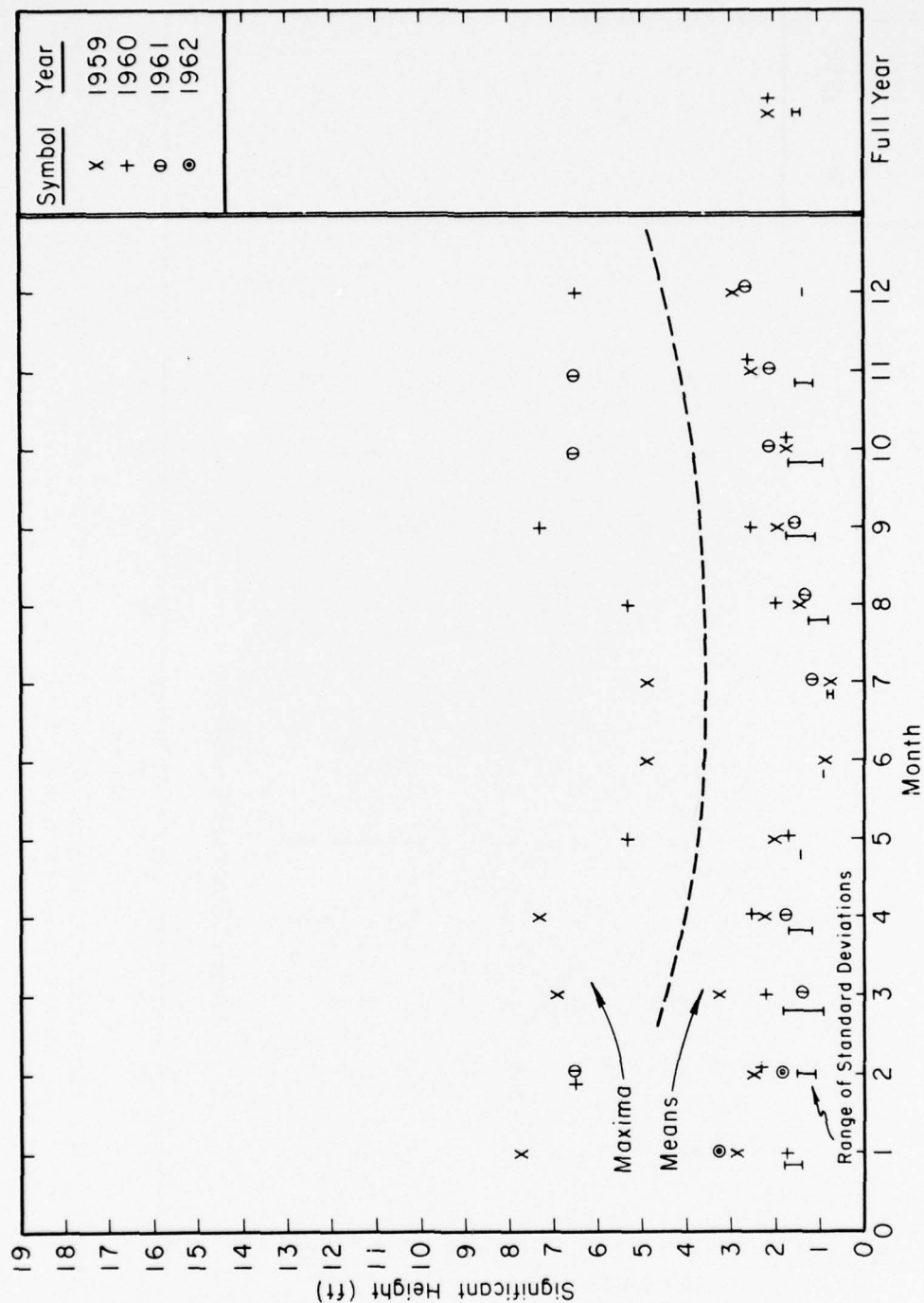


Figure A-53. Maxima, means, and standard deviations of significant height from Palm Beach, Florida; determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Tables A-34 and A-35).

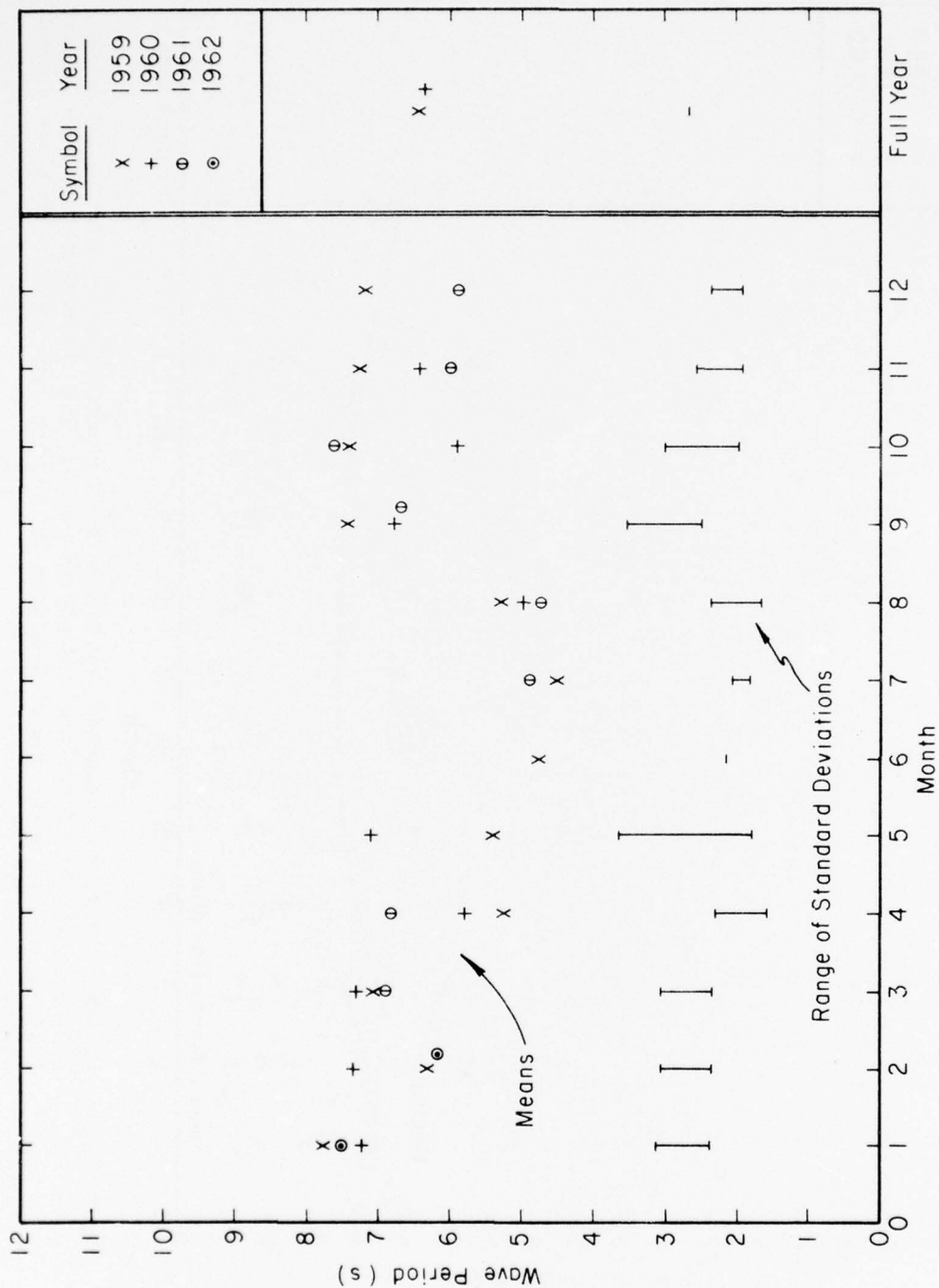
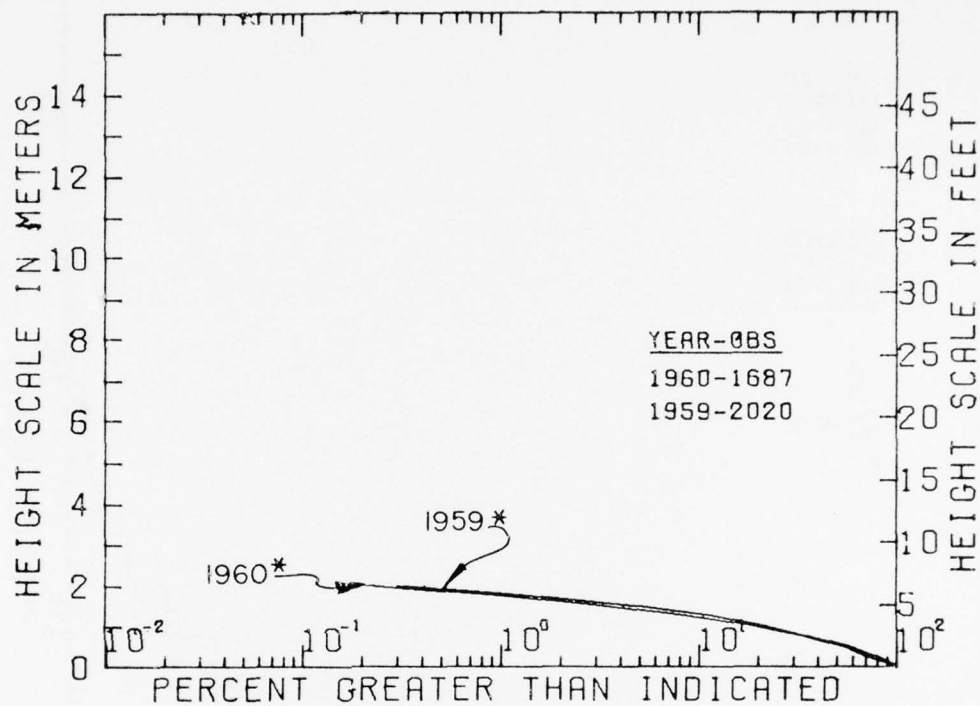


Figure A-54. Means and standard deviations of wave periods for Palm Beach, Florida; determined by an old analysis method from 7-minute pen and ink records taken six times daily



NOTE:

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Tables A-34 and A-35).

Figure A-55. Annual cumulative significant height distributions from Palm Beach, Florida.

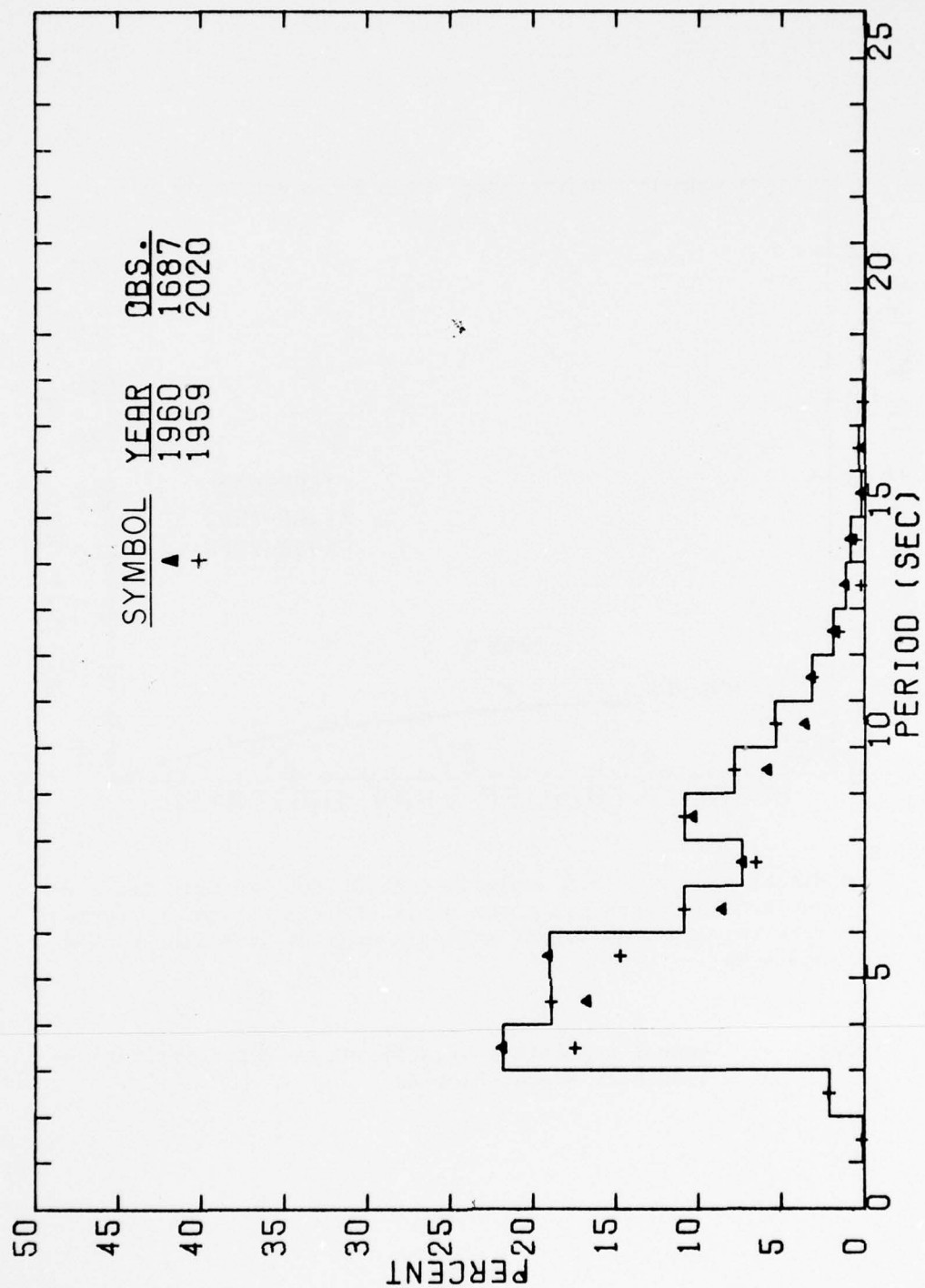
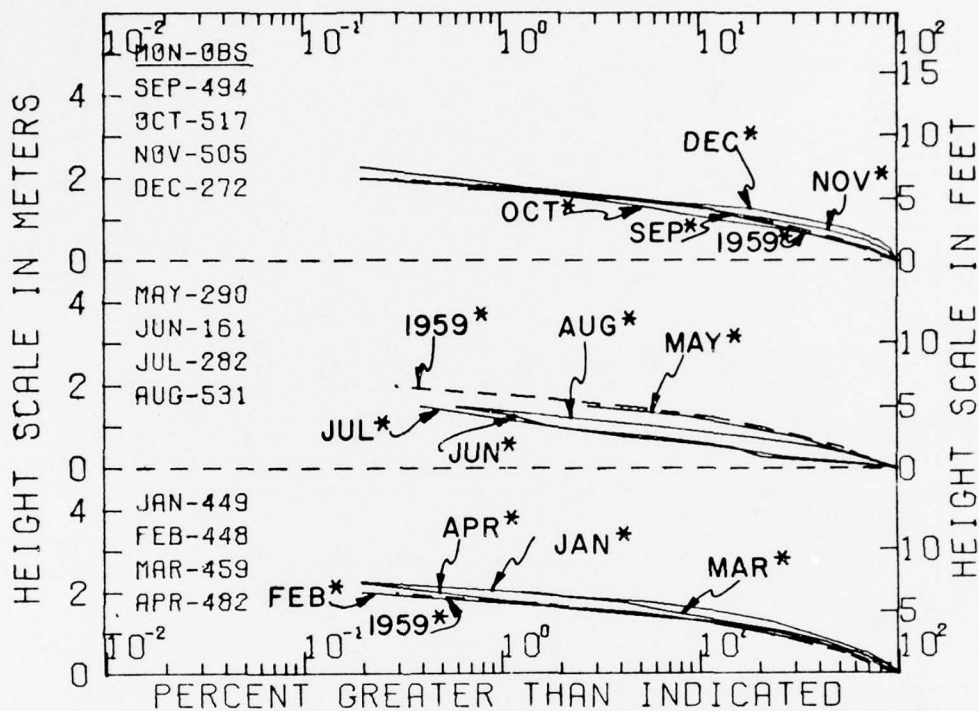


Figure A-56. Annual significant period distributions from Palm Beach, Florida; determined by an old analysis method from 7-minute pen and ink records taken six times daily.



NOTE:

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Tables A-34 and A-35).

Figure A-57. Seasonal summaries of cumulative significant height distributions from Palm Beach, Florida.

Table A-33. Wave climate for Palm Beach, Florida.
Distribution of significant height versus period
(in observations per 1,000 observations).

449 OBSERVATIONS												SUMMARY FOR JAN 59 JAN 60 JAN 62		
PERIOD (SECS)	HEIGHT (FT)													
	0-.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	=8.1	TOT.*	CUM. TOT.*	NO. TOT.*	AVG.*
0.0 - 1.9	65											1000	1000	1.00
2.0 - 2.4												1000	1000	1.00
2.5 - 2.9												1000	1000	1.00
3.0 - 3.4	20	16	4								43	1000	1000	1.92
3.5 - 3.9	13	24	7	7							60	957	957	1.53
4.0 - 4.9	11	9	42	27	13	2	2				114	848	848	2.33
5.0 - 5.9	7	13	27	27	9	31	9	9			140	783	783	3.23
6.0 - 6.9	13	24	13	9	9	20	16	2			114	643	643	2.87
7.0 - 7.9	9	18	27	11	9			2			81	529	529	2.09
8.0 - 8.9	9	24	27	31	24	16	13	4			160	448	448	2.92
9.0 - 9.9	2	13	18	18	18	11	13	9	2		112	288	288	3.44
10.0 - 10.9		2	13	13	11	9	7	9			69	176	176	3.69
11.0 - 11.9	2	4	7	7		7	4	4	2		40	107	107	3.57
12.0 - 12.9	2	2	2	4	4	7		2			26	67	67	3.30
13.0 - 13.9	2										5	40	40	3.83
14.0 - 14.9		4	2			2	4		2		17	36	36	3.78
15.0 - 15.9										2	2	19	19	7.72
16.0 - 16.9				2		2	2	2			12	17	17	5.12
17.0 - 17.9		2					2				5	5	5	3.26
TOTAL	156	165	189	156	98	107	73	45	9	2				2.68
CUM. TOTAL	1000	844	679	490	334	236	129	56	11	2				
COL. AVG.	5.87*	6.90	7.07	7.55	8.00	8.17	9.02	9.25	13.00	15.50	7.56			

AVERAGE SIG. HEIGHT = 2.70 FT
VARIANCE OF SIG. HEIGHT = 2.89 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.70 FT
AVERAGE WAVE PERIOD = 7.56 SEC*
VARIANCE OF WAVE PERIOD = 8.42 SEC SQ*
STANDARD DEVIATION OF PERIOD = 2.90 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
WAVE GAGE LOCATED AT PALM BEACH PIER
* CALMS ARE OMITTED.

448 OBSERVATIONS												SUMMARY FOR FEB 59 FEB 60 FEB 62		
PERIOD (SECS)	HEIGHT (FT)													
	0-.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	TOT.*	CUM. TOT.*	NO. TOT.*	AVG.*	
0.0 - 1.9	27										1000	1000	1.00	
2.0 - 2.4											1000	1000	1.00	
2.5 - 2.9											1000	1000	1.00	
3.0 - 3.4	36	36	2	2	2					80	1000	1000	1.00	
3.5 - 3.9	11	33	40	4						42	920	920	1.58	
4.0 - 4.9	11	29	56	42	13					156	828	828	2.14	
5.0 - 5.9	22	29	40	36	31	18	2			183	672	672	2.44	
6.0 - 6.9	16	36	9	4	11	13	16			108	489	489	2.53	
7.0 - 7.9	9	25	22	4	11	2				76	381	381	1.95	
8.0 - 8.9	2	16	27	27	9	2	4			89	305	305	2.50	
9.0 - 9.9	4	25	20	16	9	11	7	2		96	216	216	2.66	
10.0 - 10.9		11	18	7		4	2	2		46	119	119	2.57	
11.0 - 11.9			7	11		2			2	23	73	73	3.18	
12.0 - 12.9		2	7	9	2	2				23	50	50	2.69	
13.0 - 13.9					2		2			7	28	28	3.40	
14.0 - 14.9		4		2		2				11	21	21	3.02	
15.0 - 15.9	2					2	2	2		7	9	9	3.93	
16.0 - 16.9										2	2	2	4.48	
TOTAL	141	248	248	165	92	60	38	7	2				2.21	
CUM. TOTAL	1000	859	612	364	199	107	47	9	2					
COL. AVG.	5.23*	6.27	6.55	7.22	6.71	8.24	8.85	11.83	11.50	6.70				

AVERAGE SIG. HEIGHT = 2.23 FT
VARIANCE OF SIG. HEIGHT = 1.77 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.33 FT
AVERAGE WAVE PERIOD = 6.70 SEC*
VARIANCE OF WAVE PERIOD = 7.60 SEC SQ*
STANDARD DEVIATION OF PERIOD = 2.76 SEC*

459 OBSERVATIONS

SUMMARY FOR MAR 59 MAR 60 MAR 61

PERIOD
(SECS)

HEIGHT (FT)

	0=.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	TOT.*	CUM. TOT.*	RD- TOT.*	AVG.*
1.0 = 1.9	44										1000	1.00	
2.0 = 2.4											1000	1.00	
2.5 = 2.9											1000	1.00	
3.0 = 3.4											1000	1.00	
3.5 = 3.9	24	4	2								32	1000	1.14
4.0 = 4.9	26	20	7	7							62	968	1.14
4.5 = 4.9	15	31	26	37	20	4					159	907	2.22
5.0 = 5.9	24	26	26	39	31	28	4	7			194	768	2.75
6.0 = 6.9	26	17	4	15	13	9	13	4			109	574	2.58
7.0 = 7.9	15	41	17	4	2	2	2	2	2		96	465	1.91
8.0 = 8.9	7	37	37	22	17	7	7	7	4		150	369	2.67
9.0 = 9.9		15	24	9	11	4					66	219	2.58
10.0 = 10.9		7	9	17	15	2	2	2	4		62	153	3.33
11.0 = 11.9	2	4	11	11	13	4		2	2		52	91	3.10
12.0 = 12.9		4	7	7	7			2	2		30	39	3.04
13.0 = 13.9											2	9	4.68
14.0 = 14.9			2	2		2					7	7	3.13
TOTAL	181	205	176	172	129	65	31	28	13				2.37
CUM. TOTAL	1000	819	614	438	266	137	72	41	13				
COL. AVG.	5.28*	6.86	7.67	7.24	7.79	7.33	7.57	8.19	9.50	7.11			

AVERAGE SIG. HEIGHT = 2.39 FT

AVERAGE WAVE PERIOD = 7.11 SEC*

VARIANCE OF SIG. HEIGHT = 2.43 FT SQ

VARIANCE OF WAVE PERIOD = 6.38 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.56 FT

STANDARD DEVIATION OF PERIOD = 2.53 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
WAVE GAGE LOCATED AT PALM BEACH PIER

* CALMS ARE OMITTED.

482 OBSERVATIONS

SUMMARY FOR APR 59 APR 60 APR 61

PERIOD
(SECS)

HEIGHT (FT)

	0=.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	=8.1	TOT.*	CUM. TOT.*	RD- TOT.*	AVG.*
1.0 = 1.9	100	2									2	1000	1.24	
2.0 = 2.4	12										14	988	1.43	
2.5 = 2.9	4										5	984	1.43	
3.0 = 3.4	46	12	6								71	979	1.74	
3.5 = 3.9	39	39	19	10							120	908	1.23	
4.0 = 4.9	17	25	56	37	27	10	2				191	788	2.40	
5.0 = 5.9	6	17	27	44	54	35	6	2			212	597	3.16	
6.0 = 6.9	8	27	15	23	21	17	4			2	129	385	2.75	
7.0 = 7.9	19	25	6	4	8	4					74	256	1.69	
8.0 = 8.9	4	33	10	12	4	6	2				81	182	2.11	
9.0 = 9.9		6	8	15	8	6	2	2			54	101	3.10	
10.0 = 10.9	2	4	4	4		2		2			21	48	2.59	
11.0 = 11.9		4	2		2		2	2			14	28	3.26	
12.0 = 12.9			4	2			2	2			12	14	3.66	
13.0 = 13.9												2	2	1.00
14.0 = 14.9				2							2	2	2.86	
TOTAL	257	193	158	154	124	81	21	10		2				
CUM. TOTAL	1000	743	550	392	239	114	33	12	2	2				
COL. AVG.	4.41*	6.11	5.82	6.31	6.05	6.35	7.60	9.90	1.00	6.50	5.89			

AVERAGE SIG. HEIGHT = 2.14 FT

AVERAGE WAVE PERIOD = 5.90 SEC*

VARIANCE OF SIG. HEIGHT = 2.16 FT SQ

VARIANCE OF WAVE PERIOD = 4.72 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.47 FT

STANDARD DEVIATION OF PERIOD = 2.17 SEC*

290 OBSERVATIONS

SUMMARY FOR MAY 59 MAY 60

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1-.7	2-.5	3-.3	4-.1	4-.9	5-.7	TOT.	CUM. TOT.	NO. AVG.
0.0 - 1.9	193								1000	.00
2.0 - 2.4	3								1000	.43
2.5 - 2.9									996	.00
3.0 - 3.4	66	28	5					120	996	.71
3.5 - 3.9	21	31	14	3				85	876	1.23
4.0 - 4.9	24	66	62	55	24		3	291	791	2.06
5.0 - 5.9	10	21	14	45	17	17		154	500	2.63
6.0 - 6.9	5	14	7	7	10	17	10	85	346	3.22
7.0 - 7.9		14	3	5				26	261	1.64
8.0 - 8.9	14	7	17	7	3			60	235	1.70
9.0 - 9.9	7		3	7	3	7		34	175	2.65
10.0 - 10.9	5	7	10	10		3	3	47	141	2.49
11.0 - 11.9		10	3		3		3	26	94	2.45
12.0 - 12.9	3	3		7	3	3		26	68	2.56
13.0 - 13.9				3	7	7	7	30	43	4.24
14.0 - 14.9				5	5	5		15	13	3.66
TOTAL	348	200	138	152	76	59	28			1.80
CUM. TOTAL	1000	652	452	314	162	86	28			
COL. AVG.	4.82	5.50	5.92	6.55	7.36	8.44	9.12	6.15		

AVERAGE SIG. HEIGHT = 1.82 FT

AVERAGE WAVE PERIOD = 6.15 SEC

VARIANCE OF SIG. HEIGHT = 1.97 FT SQ

VARIANCE OF WAVE PERIOD = 8.36 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.38 FT

STANDARD DEVIATION OF PERIOD = 2.89 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
WAVE GAGE LOCATED AT PALM BEACH PIER

* CALMS ARE OMITTED.

161 OBSERVATIONS

SUMMARY FOR JUN 59

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1-.7	2-.5	3-.3	4-.1	4-.9	5-.7	TOT.	CUM. TOT.	NO. AVG.
0.0 - 1.9	311								1000	.00
2.0 - 2.4	75							108	1000	.43
2.5 - 2.9	6	6						18	992	.83
3.0 - 3.4	137	6	12					225	874	.59
3.5 - 3.9	118		12					189	649	.58
4.0 - 4.9	57	25	31	6	6			151	459	1.43
5.0 - 5.9	12		12	19		6		72	306	2.25
6.0 - 6.9	12	6	6	6			6	54	234	2.04
7.0 - 7.9	19							27	180	.43
8.0 - 8.9	50	12		6				99	153	.79
9.0 - 9.9	12		6	6				36	54	1.44
10.0 - 10.9		6	6					18	18	1.64
TOTAL	789	62	87	43	6	6	6			.80
CUM. TOTAL	1000	211	149	62	19	12	6			
COL. AVG.	4.32	5.80	5.29	6.50	4.50	5.50	6.50	4.75		

AVERAGE SIG. HEIGHT = .82 FT

AVERAGE WAVE PERIOD = 4.75 SEC

VARIANCE OF SIG. HEIGHT = .70 FT SQ

VARIANCE OF WAVE PERIOD = 4.67 SEC SQ

STANDARD DEVIATION OF HEIGHT = .84 FT

STANDARD DEVIATION OF PERIOD = 2.16 SEC

282 OBSERVATIONS

SUMMARY FOR JUL 59 JUL 61

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1.7	2.5	3.3	4.1	4.9	5.7	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	344								1000	.00
2.0 - 2.4	21							32	1000	.43
2.5 - 2.9	14							22	968	.43
3.0 - 3.4	89	28	14					200	946	.78
3.5 - 3.9	113	18	14					222	746	.68
4.0 - 4.9	89	46	35	28				303	524	1.25
5.0 - 5.9	14	18	11	7				76	222	1.41
6.0 - 6.9	7		4				4	22	146	2.04
7.0 - 7.9	7	4						16	124	.70
8.0 - 8.9	11	18	4					49	108	1.05
9.0 - 9.9	7	7	7	4				38	59	1.47
10.0 - 10.9	4							5	22	.43
11.0 - 11.9		4	4					11	16	1.64
12.0 - 12.9	4							5	5	.43
TOTAL	723	142	92	39			4			.80
CUM. TOTAL	1000	277	135	43	4	4	4			
COL. AVG.	4.26*	5.28	5.19	5.14	.00	.00	6.50	4.68		

AVERAGE SIG. HEIGHT = .82 FT AVERAGE WAVE PERIOD = 4.68 SEC*
 VARIANCE OF SIG. HEIGHT = .51 FT SQ VARIANCE OF WAVE PERIOD = 3.74 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .71 FT STANDARD DEVIATION OF PERIOD = 1.93 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT PALM BEACH PIER
 * CALMS ARE OMITTED.

531 OBSERVATIONS

SUMMARY FOR AUG 59 AUG 60 AUG 61

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1.7	2.5	3.3	4.1	4.9	5.7	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	94								1000	.00
2.0 - 2.4	2							2	1000	.43
2.5 - 2.9	6							6	998	.43
3.0 - 3.4	81	68	9	2				177	992	.89
3.5 - 3.9	56	79	53	2	2			212	815	1.26
4.0 - 4.9	23	68	96	64	19			297	603	2.01
5.0 - 5.9	6	24	30	28	11	11	6	129	306	2.54
6.0 - 6.9	6	7	8	6	4	2		29	177	2.22
7.0 - 7.9	4	11		2				25	148	1.03
8.0 - 8.9	11	21	15	6				58	123	1.47
9.0 - 9.9	4	8	9	4	2			29	64	1.81
10.0 - 10.9	4	4	2	2	2			15	35	1.70
11.0 - 11.9	2	8		6	2			19	21	1.95
12.0 - 12.9	2							2	2	1.24
TOTAL	303	294	222	121	41	13	6			1.53
CUM. TOTAL	1000	697	403	181	60	19	6			
COL. AVG.	4.44*	4.94	5.01	5.61	5.74	5.64	5.50	4.98		

AVERAGE SIG. HEIGHT = 1.55 FT AVERAGE WAVE PERIOD = 4.98 SEC*
 VARIANCE OF SIG. HEIGHT = 1.05 FT SQ VARIANCE OF WAVE PERIOD = 3.90 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.02 FT STANDARD DEVIATION OF PERIOD = 1.97 SEC*

494 OBSERVATIONS

SUMMARY FOR SEP 59 SEP 60 SEP 61

PERIOD
(SECS)

HEIGHT (FT)

	0=.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	=8.1	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	85											1000	.00
2.0 - 2.4												1000	.00
2.5 - 2.9												1000	.00
3.0 - 3.4	59	51	8								128	1000	.89
3.5 - 3.9	61	61	8	2							144	872	.94
4.0 - 4.9	20	26	32	16							104	728	1.61
5.0 - 5.9	6	20	34	16	14	10	8				119	624	2.60
6.0 - 6.9	4	6	6	10	8	16	14	2			73	504	3.59
7.0 - 7.9		8	6	2	6	8		2			35	431	3.06
8.0 - 8.9	10	24	16	10	8	2	2				80	396	2.00
9.0 - 9.9	10	20	24	18	2	4	6				95	316	2.22
10.0 - 10.9	10	24	10	14	20	8	2				97	223	2.43
11.0 - 11.9	4	6	14	16	6	8		2			62	126	2.74
12.0 - 12.9	6	4	2	8	2	4	2	2	4		38	64	3.24
13.0 - 13.9		4	2	2							9	27	1.84
14.0 - 14.9	2	8	2	2		2				2	18	18	2.55
TOTAL	277	263	164	117	67	63	34	8	4	2			1.91
CUM. TOTAL	1000	723	460	296	178	111	49	14	6	2			
COL. AVG.	5.25*	6.34	7.12	8.54	8.56	8.53	7.50	9.50	12.50	14.50	6.96		

AVERAGE SIG. HEIGHT = 1.93 FT

AVERAGE WAVE PERIOD = 6.96 SEC*

VARIANCE OF SIG. HEIGHT = 2.16 FT SQ

VARIANCE OF WAVE PERIOD = 9.98 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.47 FT

STANDARD DEVIATION OF PERIOD = 3.16 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

WAVE GAGE LOCATED AT PALM BEACH PIER

* CALMS ARE OMITTED.

517 OBSERVATIONS

SUMMARY FOR OCT 59 OCT 60 OCT 61

PERIOD
(SECS)

HEIGHT (FT)

	0=.9	=1.7	=2.5	=3.3	=4.1	=4.9	=5.7	=6.5	=7.3	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	79										1000	.00
2.0 - 2.4											1000	.00
2.5 - 2.9											1000	.00
3.0 - 3.4	35	21								61	1000	.73
3.5 - 3.9	21	48	12	2						90	919	1.18
4.0 - 4.9	17	44	35	15	2	2				126	849	1.67
5.0 - 5.9	27	43	35	52	12	8		2		193	723	2.10
6.0 - 6.9	2	19	17	14	12	8	4	2	2	86	529	2.80
7.0 - 7.9	19	19	8	8	4	4	8	4		80	443	2.26
8.0 - 8.9	19	19	44	19	14	4				130	363	2.04
9.0 - 9.9	12	31	27	15	8	2				103	233	1.90
10.0 - 10.9	6	15	12	10	4		2			53	130	2.01
11.0 - 11.9	4	4	15	2						27	78	1.73
12.0 - 12.9	2	10	6	10	4	2				36	50	2.28
13.0 - 13.9	2	2			2		2			8	15	2.65
14.0 - 14.9						4	2			6	6	4.75
TOTAL	246	277	211	147	60	33	17	8	2			1.82
CUM. TOTAL	1000	754	478	267	120	60	27	10	2			
COL. AVG.	6.06*	6.39	7.45	7.25	8.02	7.97	9.06	8.75	6.50	6.93		

AVERAGE SIG. HEIGHT = 1.84 FT

AVERAGE WAVE PERIOD = 6.93 SEC*

VARIANCE OF SIG. HEIGHT = 1.58 FT SQ

VARIANCE OF WAVE PERIOD = 6.99 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.26 FT

STANDARD DEVIATION OF PERIOD = 2.64 SEC*

505 OBSERVATIONS

SUMMARY FOR NOV 59 NOV 60 NOV 61

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1.7	2.5	3.3	4.1	4.9	5.7	6.5	7.3	TOT.*	CUM. TOT.*	MD*
1.0 = 1.9	22										1000	.00
2.0 = 2.4	2										1000	.43
2.5 = 2.9	6	2									8	.63
3.0 = 3.4	26	12	2								40	.75
3.5 = 3.9	22	24	10	8							65	1.29
4.0 = 4.9	14	34	69	38	12	6	2				178	2.16
5.0 = 5.9	12	26	46	51	38	20	12				204	2.78
6.0 = 6.9	10	22	26	30	20	16	4	6			136	2.78
7.0 = 7.9	14	20	20	6	4	6	2				73	3.95
8.0 = 8.9	10	26	40	50	10	8	2	4			132	2.39
9.0 = 9.9		16	18	10	12	6	2				65	2.60
10.0 = 10.9		4	12	14	4	4	2				40	2.81
11.0 = 11.9		2	6	8	12	2					30	3.02
12.0 = 12.9				4	6	4					16	4.07
13.0 = 13.9			2		4				2		6	3.13
TOTAL	137	186	250	198	121	71	26	10	2			2.34
CUM. TOTAL	1000	863	677	428	230	109	48	12	2			
COL. AVG.	4.93*	6.18	6.60	6.83	7.63	7.31	6.65	7.30	12.50	6.57		

AVERAGE SIG. HEIGHT = 2.36 FT
 VARIANCE OF SIG. HEIGHT = 1.74 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.32 FT

AVERAGE WAVE PERIOD = 6.57 SEC*
 VARIANCE OF WAVE PERIOD = 5.45 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.34 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT PALM BEACH PIER
 * CALMS ARE OMITTED.

272 OBSERVATIONS

SUMMARY FOR DEC 59 DEC 61

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1.7	2.5	3.3	4.1	4.9	5.7	6.5	TOT.*	CUM. TOT.*	MD*
1.0 = 1.9	29									1000	.00
2.0 = 2.4										1000	.00
2.5 = 2.9										1000	.00
3.0 = 3.4	15	7	11						34	1000	1.14
3.5 = 3.9		22		4					27	966	1.47
4.0 = 4.9	18	29	48	51	29	7	7		197	939	2.45
5.0 = 5.9	4	4	33	107	37	18			208	742	2.94
6.0 = 6.9		22	26	15	37	18			121	534	2.88
7.0 = 7.9	7	29	51	22	15	26	4		159	413	2.57
8.0 = 8.9	4	11	33	18	22	33			125	254	3.00
9.0 = 9.9		4		11	15	11	11	4	57	129	3.49
10.0 = 10.9			4	4	4	4			15	72	3.06
11.0 = 11.9			4			11	4		23	57	3.66
12.0 = 12.9					4	7	4		15	34	4.47
13.0 = 13.9						4			4	19	4.88
14.0 = 14.9						11		4	15	15	4.88
TOTAL	77	116	206	232	162	151	29	7			2.75
CUM. TOTAL	1000	923	787	581	349	187	47	7			
COL. AVG.	4.96*	6.12	6.36	6.01	6.77	8.62	8.62	12.00	6.71		

AVERAGE SIG. HEIGHT = 2.77 FT
 VARIANCE OF SIG. HEIGHT = 1.69 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.30 FT

AVERAGE WAVE PERIOD = 6.71 SEC*
 VARIANCE OF WAVE PERIOD = 5.20 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.28 SEC*

4490 OBSERVATIONS

SUMMARY FOR 31 MONTHS JAN 59 THROUGH FEB 62

PERIOD
(SECS)

HEIGHT (FT)

	0-.9	1.7	2.5	3.3	4.1	4.9	5.7	6.5	7.3	8.1	TOT.*	CUM. HO*	TOT.*	AVG.*
0.0 - 1.9	95											1000	1.24	
2.0 - 2.4	6										6	1000	.43	
2.5 - 2.9	3										3	994	.53	
3.0 - 3.4	47	24	6								88	990	.82	
3.5 - 3.9	37	38	18	4							107	902	1.15	
4.0 - 4.9	22	36	51	36	14	3	1				179	795	2.03	
5.0 - 5.9	13	22	30	39	23	18	5	2			167	616	2.68	
6.0 - 6.9	9	17	12	12	12	12	8	2			94	449	2.79	
7.0 - 7.9	11	19	13	6	5	4	1	1			67	355	2.05	
8.0 - 8.9	11	22	25	17	10	6	3	1			105	288	2.32	
9.0 - 9.9	4	14	16	12	8	5	3	2			70	183	2.60	
10.0 - 10.9	3	8	9	9	6	3	2	1			45	113	2.72	
11.0 - 11.9	1	4	7	6	4	3	1	1	1		31	88	2.85	
12.0 - 12.9	1	3	3	5	3	2	1	1	1		21	37	3.04	
13.0 - 13.9		1			1	1	1				6	16	3.11	
14.0 - 14.9		2		1		2	1				8	10	3.50	
15.0 - 15.9											1	3	4.88	
16.0 - 16.9											1	2	5.01	
TOTAL	263	213	189	147	85	60	27	11	3	1			2.00	
CUM. TOTAL	1000	737	524	335	188	103	43	15	4	1				
CUL. AVG.	4.91*	6.08	6.51	6.89	7.27	7.78	8.19	8.96	10.97	12.17	6.43			

AVERAGE SIG. HEIGHT = 2.02 FT

AVERAGE WAVE PERIOD = 6.42 SEC*

VARIANCE OF SIG. HEIGHT = 2.05 FT SQ

VARIANCE OF WAVE PERIOD = 7.13 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.43 FT

STANDARD DEVIATION OF PERIOD = 2.67 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

WAVE GAGE LOCATED AT PALM BEACH PIER

* CALMS ARE OMITTED.

Table A-34. Comparison of results from different pen and ink wave record analysis methods, Palm Beach, Florida.

Dates of data sample reanalyzed by CERC method	Significant heights ¹			Significant periods ²		
	Correlation between heights	A (ft)	B	Correlation between periods (s)	C	D
Feb. 1960	0.91	0.04	0.81	0.77	1.07	0.83

¹Significant height from the CERC method
 $= A + B \times (\text{significant height from old method}).$

²Significant period from the CERC method
 $= C + D \times (\text{significant period from old method}).$

Table A-35. Regression equations used to compensate significant height statistics for Palm Beach, Florida.

Year	Compensation equations (ft)
1959 to 1962	$H_{NEW} = 0.04 + 0.81 H_{OLD}$

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis.

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

Table A-36. CERC wave gage history for Lake Worth Municipal Fishing Pier, Lake Worth, Florida.

CERC Form 174-74
18 Mar 74

COORDINATES: 26°37' N., 80°02' W.

LOCATION: Lake Worth Municipal Fishing Pier, Lake Worth, Florida

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance, staff-relay type	20 Jan. 1966	27 May 1971	Gage removed; pier being rebuilt.	20	-5 to +15	18	0 (on north side of pier)	800
Continuous-wire staff	22 Jan. 1973	11 Feb. 1973	Gage damaged by storm.	20	-5 to +15	18	0	800
Continuous-wire staff	3 Aug. 1973	24 Aug. 1973	Electronics not working properly.	20	-5 to +15	18	0	800
	14 Nov. 1973	22 Feb. 1974	Electronics not working properly.					
	1 June 1974	14 June 1974	Gage struck by lightning.					
	20 Sept. 1974	1 Oct. 1974	Gage struck by lightning.					
	11 Oct. 1974	18 Mar. 1975	Gage discontinued.					

Table A-37. Number of analyzed records from Lake Worth, Florida.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1966	68	157	184	178	165	164	170	174	111	38	177	165	1751
1967	185	167	186	151	182	149	165	89					1274
1968											88		88
1969	100	108	99	71	87	67	109	117	107	59			924
1970													
1971			40	110	88								238
1972													
1973	28	36						44			58	42	208
1974	94	64				10			26	60	109	113	476
1975	97												

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the CERC method. Results after November 1968 obtained from 1,024-second digital records taken four times daily.

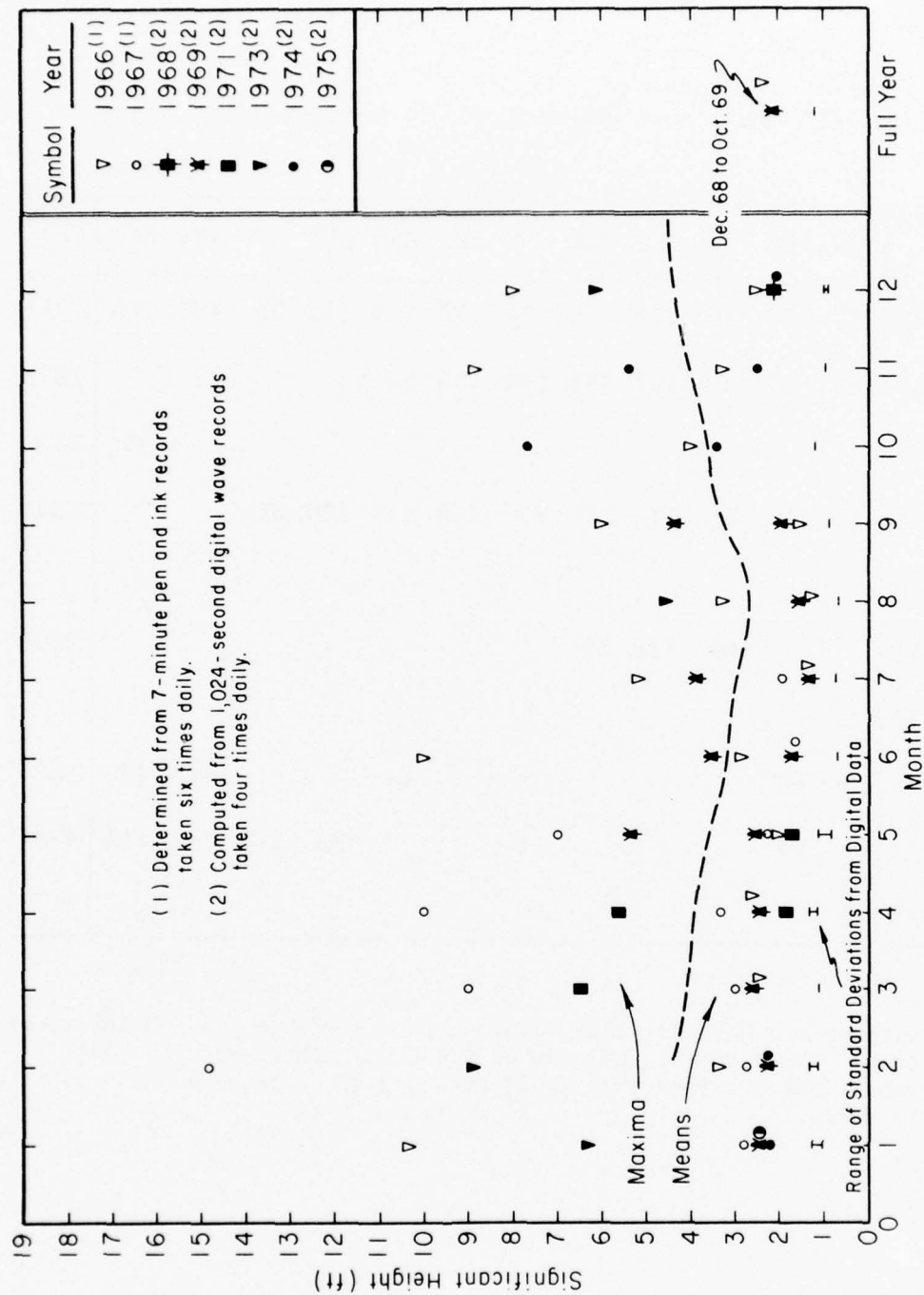


Figure A-58. Maxima, means, and standard deviations of significant height from Lake Worth, Florida.

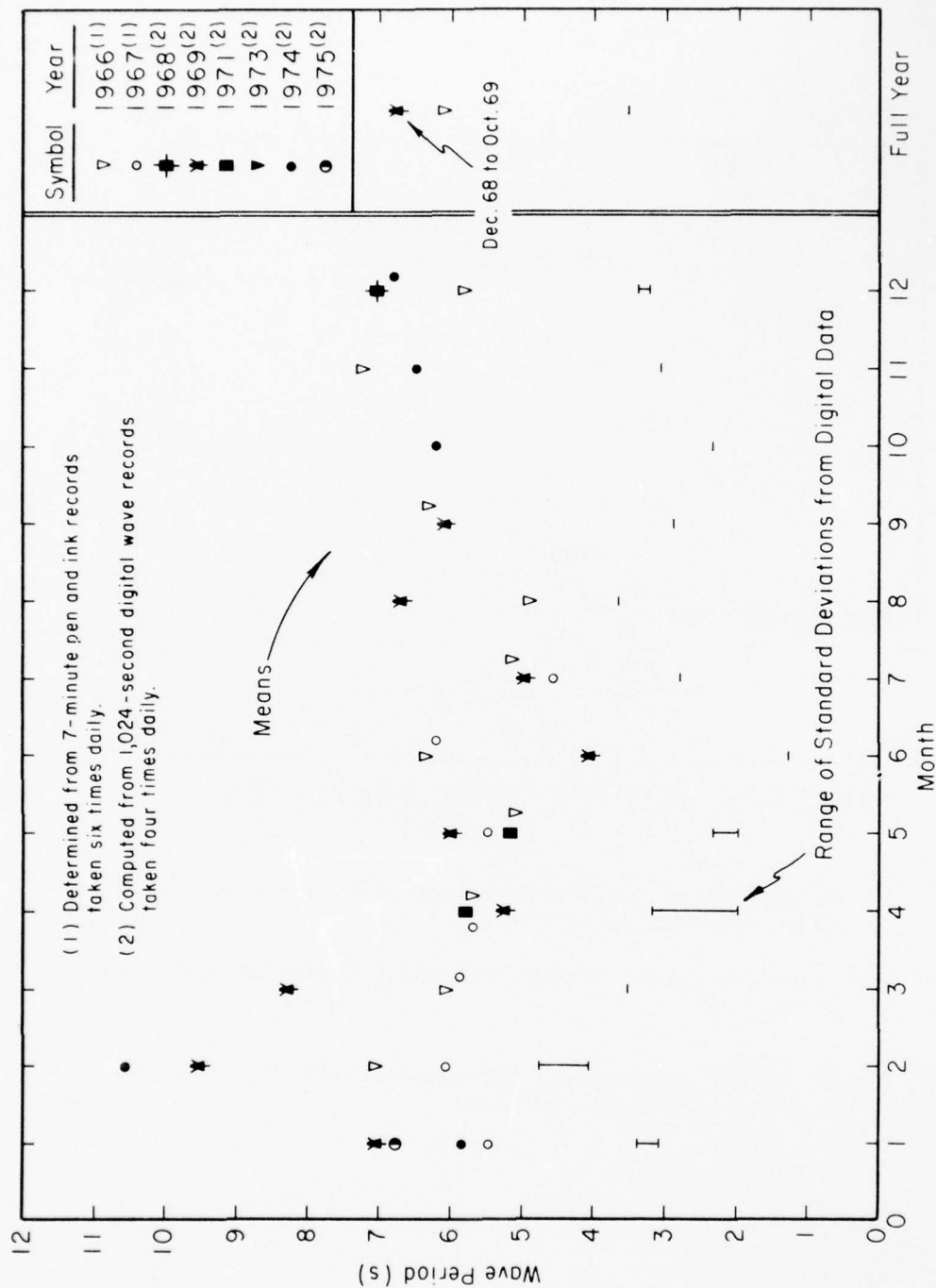
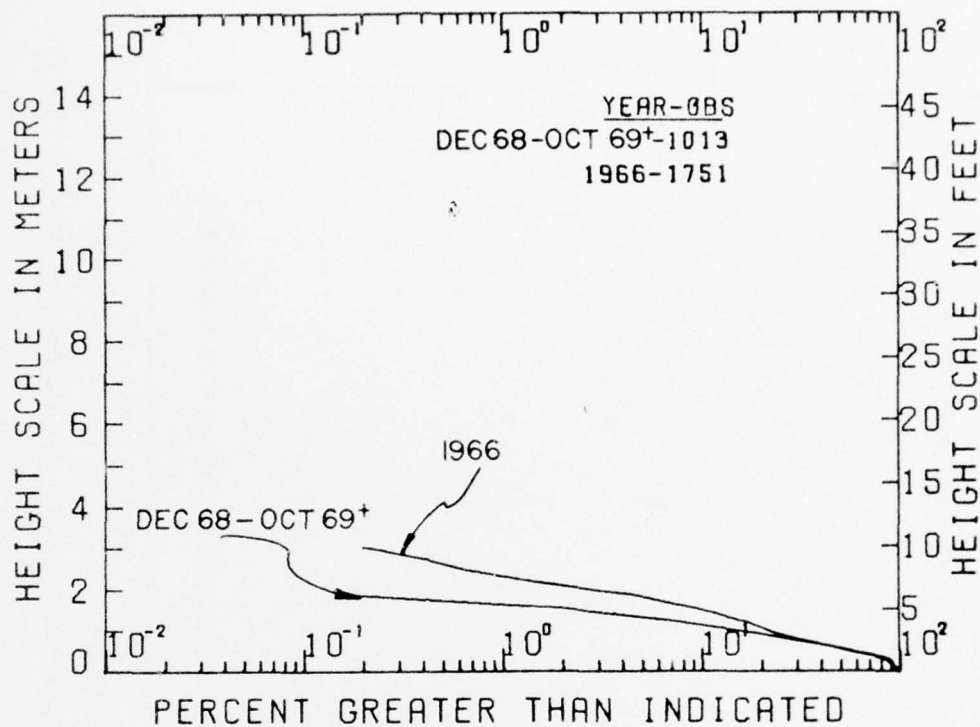


Figure A-59. Means and standard deviations of wave periods for Lake Worth, Florida.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-60. Annual cumulative significant height distributions from Lake Worth, Florida.

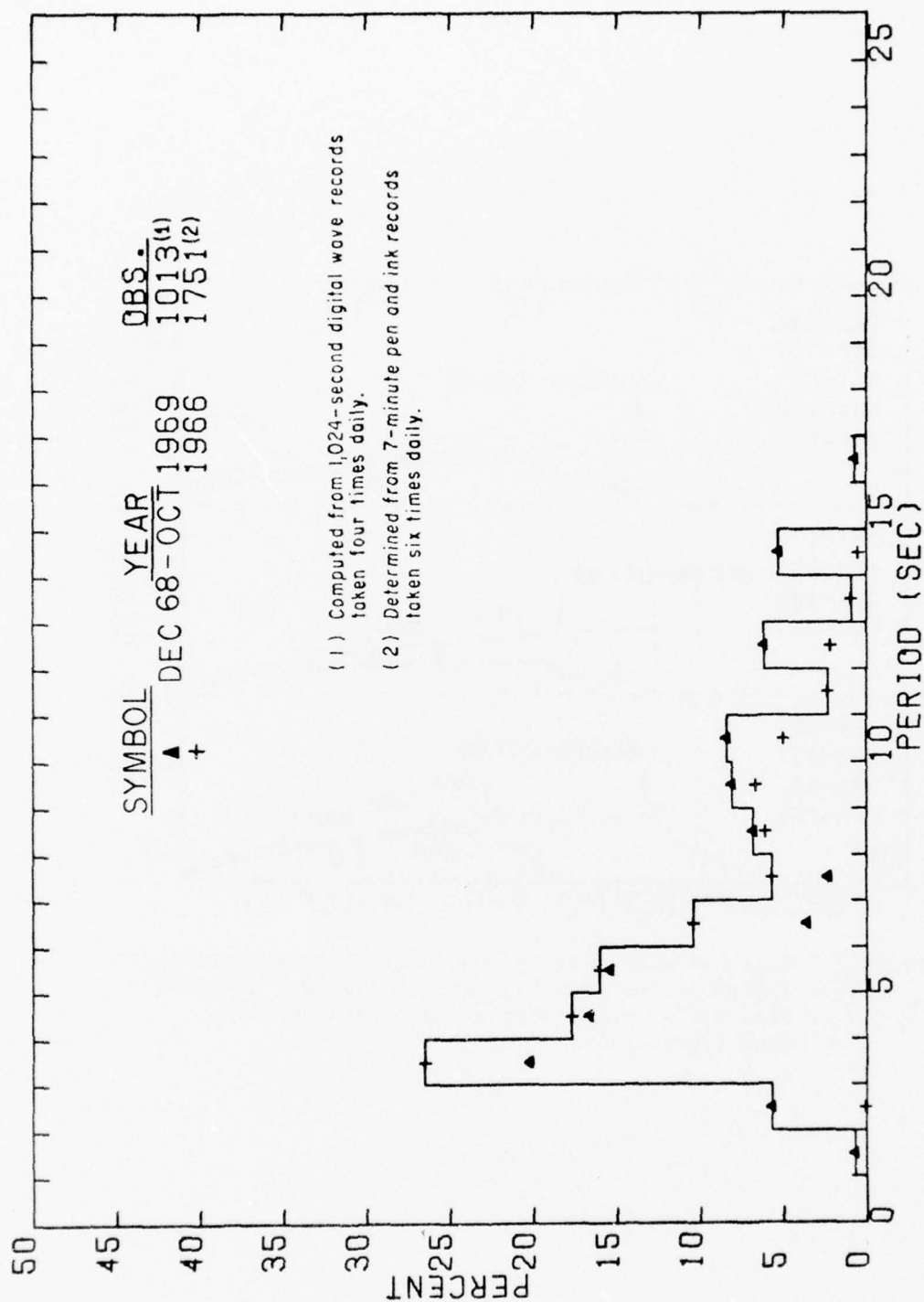


Figure A-61. Annual significant period distributions from Lake Worth, Florida.

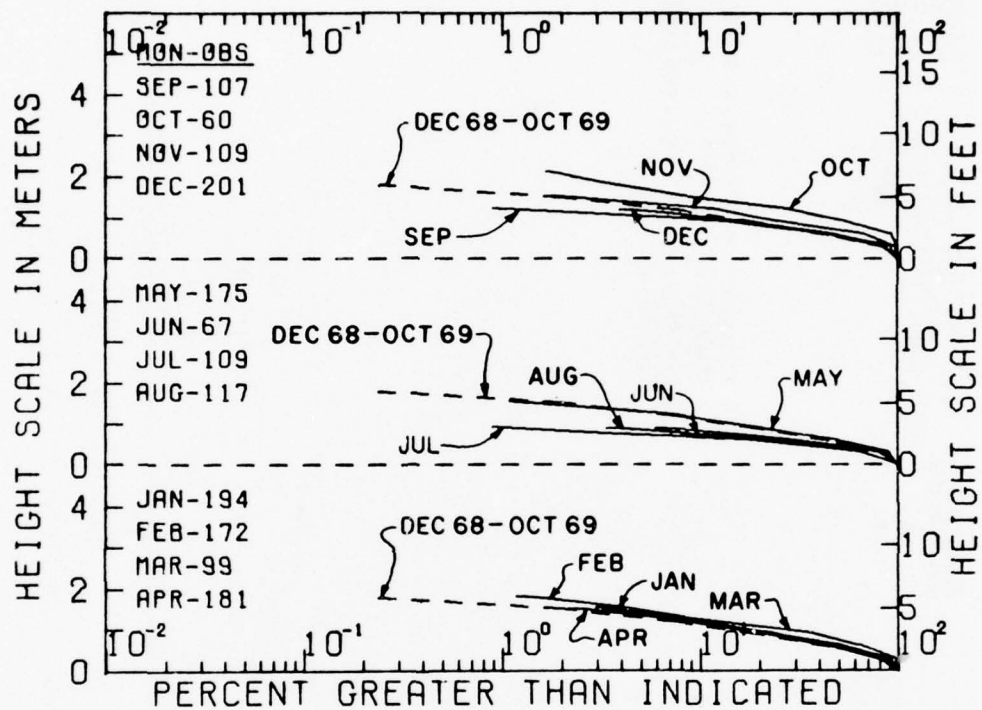


Figure A-62. Seasonal summaries of cumulative significant height distributions from Lake Worth, Florida; computed from 1,024-second digital wave records taken four times daily.

Table A-38. Wave climate for Lake Wörth, Florida.
Distribution of significant height versus period
(in observations per 1,000 observations).

194 OBSERVATIONS									
SUMMARY FOR JAN 69 JAN 74									
PERIOD (SECS)	SIG. HEIGHT (FT)						SIG. HEIGHT (FT)		
	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9								1000	1.58
3.0 - 3.9	15	57	5				62	938	1.88
4.0 - 4.9	26	36	139	52			253	804	2.36
5.0 - 5.9	5	15	41	77	26	10	175	552	3.26
6.0 - 6.9		5	5	5	21	10	46	376	4.06
7.0 - 7.9	5	31		5			41	330	1.63
8.0 - 8.9	15	21	15		5	10	67	289	2.15
9.0 - 9.9	21	41	5	5			72	227	1.43
10.0 - 10.9	10	31	15				57	149	1.59
11.0 - 11.9								93	0.00
12.0 - 12.9	5	26	5				36	93	1.50
13.0 - 13.9								57	0.00
14.0 - 14.9		46					46	57	1.50
15.0 - 15.9								10	0.00
16.0 - 16.9	5						5	10	.50
17.0 - 17.9								5	0.00
18.0 - 18.9								5	0.00
19.0 - 19.9								5	0.00
20.0 - 20.9		5					5	5	1.50
21.0 +									0.00
TOTAL	108	371	289	149	52	31			2.26
CUM. TOTAL	1000	892	521	232	82	31			
COL. AVG.	7.60*	7.67	5.21	5.33	6.20	6.83	6.50		
AVERAGE SIG. HEIGHT = 2.29 FT									
VARIANCE OF SIG. HEIGHT = 1.28 FT SQ									
STANDARD DEVIATION OF HEIGHT = 1.13 FT									
AVERAGE WAVE PERIOD = 6.48 SEC*									
VARIANCE OF WAVE PERIOD = 10.99 SEC SQ*									
STANDARD DEVIATION OF PERIOD = 3.32 SEC*									
RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP REL. AND CONT. WIRE									
WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER,									
* CALMS ARE OMITTED.									

172 OBSERVATIONS									
SUMMARY FOR FEB 69 FEB 74									
PERIOD (SECS)	SIG. HEIGHT (FT)						SIG. HEIGHT (FT)		
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	ROW. AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9	6	23	6					35	1000
3.0 - 3.9	6	81	17					105	965
4.0 - 4.9	17	6	17	6				47	860
5.0 - 5.9		12	6	29	6	17	6	76	814
6.0 - 6.9		23		12				35	738
7.0 - 7.9		35		6				41	703
8.0 - 8.9	6		17	12	6			41	663
9.0 - 9.9	12	58	35	6		6		116	622
10.0 - 10.9	12	58	6	6	6			87	506
11.0 - 11.9									419
12.0 - 12.9		87	41	23	12			163	419
13.0 - 13.9									256
14.0 - 14.9	12	47	64	12	35	6	6	180	256
15.0 - 15.9									76
16.0 - 16.9		41	6					47	76
17.0 - 17.9									29
18.0 - 18.9									29
19.0 - 19.9									29
20.0 - 20.9		23	6					29	29
21.0 +									0.00
TOTAL	70	494	221	110	64	29	12		2.24
CUM. TOTAL	1000	930	436	215	105	41	12		
COL. AVG.	8.08*	9.96	10.76	8.87	12.41	8.10	10.00	9.99	
AVERAGE SIG. HEIGHT = 2.24 FT									
VARIANCE OF SIG. HEIGHT = 1.46 FT SQ									
STANDARD DEVIATION OF HEIGHT = 1.21 FT									
AVERAGE WAVE PERIOD = 9.90 SEC*									
VARIANCE OF WAVE PERIOD = 19.13 SEC SQ*									
STANDARD DEVIATION OF PERIOD = 4.37 SEC*									

99 OBSERVATIONS

SUMMARY FOR MAR 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9		10					10	1000	1.50
3.0 - 3.9		10	10	10			30	990	2.50
4.0 - 4.9		20	20	51	30		121	960	3.25
5.0 - 5.9	10	20	30	141	20	30	253	838	3.42
6.0 - 6.9		20	20		20		61	586	2.83
7.0 - 7.9		10			10		20	525	3.00
8.0 - 8.9	10	71	10	20			111	505	1.86
9.0 - 9.9		20	20	20			61	394	2.50
10.0 - 10.9	10	40	30	10			91	333	1.94
11.0 - 11.9								242	0.00
12.0 - 12.9		51	51	10			111	242	2.14
13.0 - 13.9								131	0.00
14.0 - 14.9		40	81				121	131	2.17
15.0 - 15.9								10	0.00
16.0 - 16.9			10				10	10	2.50
TOTAL	30	313	283	263	81	30			2.64
CUM. TOTAL	1000	970	657	374	111	30			
COL. AVG.	8.17*	9.27	10.47	6.23	5.63	5.50	8.40		

AVERAGE SIG. HEIGHT = 2.61 FT AVERAGE WAVE PERIOD = 8.33 SEC*
 VARIANCE OF SIG. HEIGHT = 1.21 FT SQ VARIANCE OF WAVE PERIOD = 12.41 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.10 FT STANDARD DEVIATION OF PERIOD = 3.52 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER,
 * CALMS ARE OMITTED.

181 OBSERVATIONS

SUMMARY FOR APR 69 APR 71

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9	6	6					11	1000	1.00
2.0 - 2.9	72	55	6				133	989	1.00
3.0 - 3.9	17	138	72	6			232	856	1.79
4.0 - 4.9	11		110	11	6		138	624	2.50
5.0 - 5.9	28	11	22	77	55	17	210	486	3.32
6.0 - 6.9	6	11		6	6	6	33	276	2.83
7.0 - 7.9	11	11					22	243	1.00
8.0 - 8.9	28	17	6	6			55	221	1.30
9.0 - 9.9	33	28	17	11			88	166	1.56
10.0 - 10.9	11	22		6			39	77	1.50
11.0 - 11.9								39	0.00
12.0 - 12.9	6	6	17				28	39	1.90
13.0 - 13.9								11	0.00
14.0 - 14.9	6	6			6		11	11	1.00
TOTAL	232	309	249	122	66	22			2.65
CUM. TOTAL	1000	768	459	210	88	22			
COL. AVG.	5.95*	5.27	5.21	6.09	5.50	5.75	5.54		

AVERAGE SIG. HEIGHT = 2.08 FT AVERAGE WAVE PERIOD = 5.58 SEC*
 VARIANCE OF SIG. HEIGHT = 1.52 FT SQ VARIANCE OF WAVE PERIOD = 7.78 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.23 FT STANDARD DEVIATION OF PERIOD = 2.79 SEC*

175 OBSERVATIONS

SUMMARY FOR MAY 69 MAY 71

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9								1000	0.00
1.0 = 1.9		6					6	1000	1.50
2.0 = 2.9	17	34					51	994	1.17
3.0 = 3.9	6	97	91				200	943	1.99
4.0 = 4.9	11	46	80	63	11		211	743	2.58
5.0 = 5.9	11	57	80	46	46	11	251	531	2.86
6.0 = 6.9	11	34	6		6		57	280	1.70
7.0 = 7.9		23		6			29	223	1.90
8.0 = 8.9	17	69					86	194	1.30
9.0 = 9.9	11	34	17				63	109	1.59
10.0 = 10.9		29	11				40	46	1.79
11.0 = 11.9								6	0.00
12.0 = 12.9	6						6	6	.50
TOTAL	91	429	246	120	63	11			2.17
CUM. TOTAL	1000	909	480	194	74	11			
COL. AVG.	6.31*	5.97	5.04	4.98	5.41	5.50	5.57		

AVERAGE SIG. HEIGHT = 2.15 FT
 VARIANCE OF SIG. HEIGHT = 1.11 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.05 FT

AVERAGE WAVE PERIOD = 5.59 SEC*
 VARIANCE OF WAVE PERIOD = 4.92 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.22 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER,
 * CALMS ARE OMITTED.

67 OBSERVATIONS

SUMMARY FOR JUN 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9						1000	0.00
1.0 = 1.9		45			45	1000	1.50
2.0 = 2.9		90	15		104	954	1.64
3.0 = 3.9	60	284	90		433	851	1.57
4.0 = 4.9	15	104	75	30	224	418	2.03
5.0 = 5.9		75	45	15	134	194	2.06
6.0 = 6.9		15			15	60	1.50
7.0 = 7.9				15	15	45	3.50
8.0 = 8.9	15	15			30	30	1.00
TOTAL	90	627	224	60			1.75
CUM. TOTAL	1000	910	284	60			
COL. AVG.	4.50*	3.81	4.17	5.50	4.05		

AVERAGE SIG. HEIGHT = 1.72 FT
 VARIANCE OF SIG. HEIGHT = .44 FT SQ
 STANDARD DEVIATION OF HEIGHT = .67 FT

AVERAGE WAVE PERIOD = 4.09 SEC*
 VARIANCE OF WAVE PERIOD = 1.65 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.29 SEC*

109 OBSERVATIONS

SUMMARY FOR JUL 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	RU- AVG.*
0.0 - .9						1000	0.00
1.0 - 1.9	18	9			28	1000	.83
2.0 - 2.9	55	119			174	972	1.18
3.0 - 3.9	64	229	110		404	798	1.61
4.0 - 4.9	9	28	46		83	394	1.94
5.0 - 5.9	28	18	9	9	64	312	1.50
6.0 - 6.9	28				28	248	.50
7.0 - 7.9	9				9	220	.50
8.0 - 8.9	64	9			73	211	.63
9.0 - 9.9	37	28			64	138	.93
10.0 - 10.9	18	37			55	73	1.17
11.0 - 11.9						18	0.00
12.0 - 12.9	18				18	18	.50
TOTAL	349	477	165	9			1.33
CUM. TOTAL	1000	651	174	9			
COL. AVG.	6.16*	4.33	3.89	5.50	4.90		

AVERAGE SIG. HEIGHT = 1.37 FT

AVERAGE WAVE PERIOD = 4.95 SEC*

VARIANCE OF SIG. HEIGHT = .46 FT SQ

VARIANCE OF WAVE PERIOD = 7.82 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .68 FT

STANDARD DEVIATION OF PERIOD = 2.80 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE

WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER.

* CALMS ARE OMITTED.

117 OBSERVATIONS

SUMMARY FOR AUG 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	RU- AVG.*
0.0 - .9						1000	0.00
1.0 - 1.9						1000	0.00
2.0 - 2.9	9	43	9		60	1000	1.50
3.0 - 3.9	17	162	68	9	256	940	1.77
4.0 - 4.9	26	94	60	26	205	684	1.92
5.0 - 5.9	17	9	34		60	479	1.79
6.0 - 6.9	9	9			17	419	1.00
7.0 - 7.9						402	0.00
8.0 - 8.9	9	43			51	402	1.33
9.0 - 9.9	51	94			145	350	1.15
10.0 - 10.9	43	68	9		120	205	1.21
11.0 - 11.9						85	0.00
12.0 - 12.9	9	17			26	85	1.17
13.0 - 13.9						60	0.00
14.0 - 14.9	9	34			43	60	1.30
15.0 - 15.9						17	0.00
16.0 - 16.9	9	9			17	17	1.00
TOTAL	205	581	179	34			1.54
CUM. TOTAL	1000	795	214	34			
COL. AVG.	8.42*	6.93	4.50	4.25	6.71		

AVERAGE SIG. HEIGHT = 1.56 FT

AVERAGE WAVE PERIOD = 6.71 SEC*

VARIANCE OF SIG. HEIGHT = .42 FT SQ

VARIANCE OF WAVE PERIOD = 13.45 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .64 FT

STANDARD DEVIATION OF PERIOD = 3.67 SEC*

107 OBSERVATIONS

SUMMARY FOR SEP 69

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	RD=
0.0 - .9							1000	0.00
1.0 - 1.9	9						9	1000 .50
2.0 - 2.9	9	37	9				56	991 1.50
3.0 - 3.9	9	103	84				196	935 1.88
4.0 - 4.9	28	112	93	37	9		280	738 2.10
5.0 - 5.9	9	9	28	56			103	458 2.77
6.0 - 6.9		9	19				28	355 2.17
7.0 - 7.9		9					9	327 1.50
8.0 - 8.9	28	37	9				75	318 1.25
9.0 - 9.9	56	28	9	9			103	243 1.23
10.0 - 10.9	19	47	37	9			112	140 1.83
11.0 - 11.9								28 0.00
12.0 - 12.9			9	19			28	28 3.17
TOTAL	168	393	299	131	9			1.92
CUM. TOTAL	1000	832	439	140	9			
COL. AVG.	7.22*	5.64	5.66	6.86	4.50	6.06		

AVERAGE SIG, HEIGHT = 1.95 FT

VARIANCE OF SIG, HEIGHT = .73 FT SQ

STANDARD DEVIATION OF HEIGHT = .86 FT

AVERAGE WAVE PERIOD = 6.11 SEC*

VARIANCE OF WAVE PERIOD = 8.32 SEC SQ*

STANDARD DEVIATION OF PERIOD = 2.88 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES, AND CONT. WIRE

WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER.

* CALMS ARE OMITTED.

60 OBSERVATIONS

SUMMARY FOR OCT 74

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	RD=
0.0 - .9										1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9										1000	0.00
3.0 - 3.9		17	33							50	1000 2.17
4.0 - 4.9			217	33	17					267	950 2.75
5.0 - 5.9		17	83	200	100					400	683 3.46
6.0 - 6.9			17	17		17		17		67	283 4.75
7.0 - 7.9											217 0.00
8.0 - 8.9		17		17	17	17	17			83	217 4.30
9.0 - 9.9						17				17	133 5.50
10.0 - 10.9					67					67	117 4.50
11.0 - 11.9											50 0.00
12.0 - 12.9			33							33	50 2.50
13.0 - 13.9											17 0.00
14.0 - 14.9		17								17	17 1.50
TOTAL		67	383	267	200	50	17	17			3.40
CUM. TOTAL	1000	1000	933	550	283	83	33	17			
COL. AVG.	0.00*	8.00	5.41	5.63	7.33	8.17	8.50	6.50	6.23		

AVERAGE SIG, HEIGHT = 3.37 FT

VARIANCE OF SIG, HEIGHT = 1.42 FT SQ

STANDARD DEVIATION OF HEIGHT = 1.19 FT

AVERAGE WAVE PERIOD = 6.23 SEC*

VARIANCE OF WAVE PERIOD = 5.67 SEC SQ*

STANDARD DEVIATION OF PERIOD = 2.38 SEC*

100 OBSERVATIONS

SUMMARY FOR NOV 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9	9	46					55	1000	1.33
3.0 - 3.9		83	28				110	945	1.75
4.0 - 4.9		37	147	18			202	835	2.41
5.0 - 5.9		9	101	75	101	9	294	633	3.50
6.0 - 6.9			18				18	339	2.50
7.0 - 7.9		18	18				37	321	2.00
8.0 - 8.9	18		28	18			64	284	2.21
9.0 - 9.9		28	18				46	220	1.90
10.0 - 10.9		18	46				64	174	2.21
11.0 - 11.9								110	0.00
12.0 - 12.9			28	18	18	9	73	110	2.75
13.0 - 13.9								37	0.00
14.0 - 14.9			28	9			37	37	2.00
TOTAL	28	294	422	158	101	18			2.55
CUM. TOTAL	1000	972	679	257	119	18			
COL. AVG.	6.50*	6.66	6.37	7.30	5.50	9.00	6.55		

AVERAGE SIG. HEIGHT = 2.50 FT

AVERAGE WAVE PERIOD = 6.51 SEC*

VARIANCE OF SIG. HEIGHT = .98 FT SQ

VARIANCE OF WAVE PERIOD = 9.61 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .99 FT

STANDARD DEVIATION OF PERIOD = 3.10 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE

* WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER.

* CALMS ARE OMITTED.

201 OBSERVATIONS

SUMMARY FOR DEC 68 DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9							1000	0.00
1.0 - 1.9							1000	0.00
2.0 - 2.9	5	35				40	1000	1.38
3.0 - 3.9	10	50	65	10		134	960	2.06
4.0 - 4.9		55	95	45	10	204	826	2.55
5.0 - 5.9	15	35	45	50	30	174	622	2.76
6.0 - 6.9	5	20	5			30	448	1.50
7.0 - 7.9	10	30				40	418	1.25
8.0 - 8.9	20	70	35	10		134	378	1.76
9.0 - 9.9		15	20	15		50	244	2.50
10.0 - 10.9	10	55	15			80	194	1.56
11.0 - 11.9							114	0.00
12.0 - 12.9		45	15			60	114	1.75
13.0 - 13.9							55	0.00
14.0 - 14.9		30	10			40	55	1.75
15.0 - 15.9							15	0.00
16.0 - 16.9		15				15	15	1.50
TOTAL	75	453	303	129	40			2.11
CUM. TOTAL	1000	925	473	169	40			
COL. AVG.	6.83*	7.95	6.27	5.69	5.25	6.96		

AVERAGE SIG. HEIGHT = 2.06 FT

AVERAGE WAVE PERIOD = 6.95 SEC*

VARIANCE OF SIG. HEIGHT = .84 FT SQ

VARIANCE OF WAVE PERIOD = 11.07 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .92 FT

STANDARD DEVIATION OF PERIOD = 3.33 SEC*

1591 OBSERVATIONS

SUMMARY FOR 17 MONTHS DEC 68 THROUGH DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - .9										1000	0.00
1.0 - 1.9	3	4							6	1000	1.10
2.0 - 2.9	17	45	4						66	994	1.30
3.0 - 3.9	15	102	61	4					182	928	1.80
4.0 - 4.9	13	41	89	32	6				181	745	2.38
5.0 - 5.9	11	23	41	59	31	9	1		175	564	3.09
6.0 - 6.9	5	14	6	3	5	3		1	36	389	2.50
7.0 - 7.9	4	18	1	3	1				26	353	1.67
8.0 - 8.9	19	33	12	6	2	2	1		75	327	1.79
9.0 - 9.9	19	34	14	6		1			74	252	1.67
10.0 - 10.9	11	37	14	3	3				68	178	1.75
11.0 - 11.9										110	0.00
12.0 - 12.9	4	25	15	6	1	1			52	110	2.06
13.0 - 13.9										58	0.00
14.0 - 14.9	3	23	13	2	4	1	1		45	58	2.19
15.0 - 15.9										13	0.00
16.0 - 16.9	1	7	1						9	13	1.50
17.0 - 17.9										4	0.00
18.0 - 18.9										4	0.00
19.0 - 19.9										4	0.00
20.0 - 20.9		3	1						4	4	1.67
21.0 +											0.00
TOTAL	124	409	272	124	53	16	2	1			2.13
CUM. TOTAL	1000	876	467	195	71	18	3	1			
COL. AVG.	6.80*	6.91	6.22	6.15	6.71	6.98	9.50	6.50	6.61		

AVERAGE SIG. HEIGHT = 2.13 FT

AVERAGE WAVE PERIOD = 6.61 SEC*

VARIANCE OF SIG. HEIGHT = 1.20 FT SQ

VARIANCE OF WAVE PERIOD = 12.15 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.10 FT

STANDARD DEVIATION OF PERIOD = 3.49 SEC*

RESULTS OBTAINED FROM 1024*SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE

* WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER.

* CALMS ARE OMITTED.

2830 OBSERVATIONS

SUMMARY FOR 17 MONTHS FEB 66 THROUGH JUL 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13 +	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 - 1.9	21															1000	0.00
2.0 - 2.9																1000	3.50
2.5 - 2.9																1000	0.00
3.0 - 3.9	42	93	16												155	1000	1.32
3.5 - 3.9	13	82	45	9	1										153	845	1.85
4.0 - 4.9	10	65	68	42	10	1									201	642	2.40
5.0 - 5.9	10	27	28	36	31	12	2	1							151	491	3.20
6.0 - 6.9	7	14	7	7	16	18	12	6							88	341	4.16
7.0 - 7.9	6	17	6	2	3	2	5	1	2	1					47	253	3.35
8.0 - 8.9	13	23	9	1	1	2	1	1	1						53	206	2.08
9.0 - 9.9	14	25	12	3	1	1	1			1					61	153	1.98
10.0 - 10.9	8	19	11	3	1	1					1				48	92	1.96
11.0 - 11.9	4	8	4	1	1		1	1							20	48	2.37
12.0 - 12.9	4	4	2		1	1									16	28	3.02
13.0 - 13.9	2	3			1	2									9	14	4.23
14.0 - 14.9						1	1	1							4	8	6.00
TOTAL	148	379	212	106	65	43	27	11	4	2	1			1			
CUM. TOTAL	1000	852	473	281	156	90	47	20	4	5	2	1		1			
COL. AVG.	5.80*	5.67	5.70	5.50	5.48	7.30	8.03	7.82	8.50	8.21	10.63	12.50	1.00	13.50	5.82		

AVERAGE SIG. HEIGHT = 2.40 FT

AVERAGE WAVE PERIOD = 5.82 SEC*

VARIANCE OF SIG. HEIGHT = 2.79 FT SQ

VARIANCE OF WAVE PERIOD = 6.56 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.67 FT

STANDARD DEVIATION OF PERIOD = 2.56 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

* WAVE GAGE LOCATED AT MUNICIPAL FISHING PIER.

* CALMS ARE OMITTED.

APPENDIX A-2

SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. GULF COAST

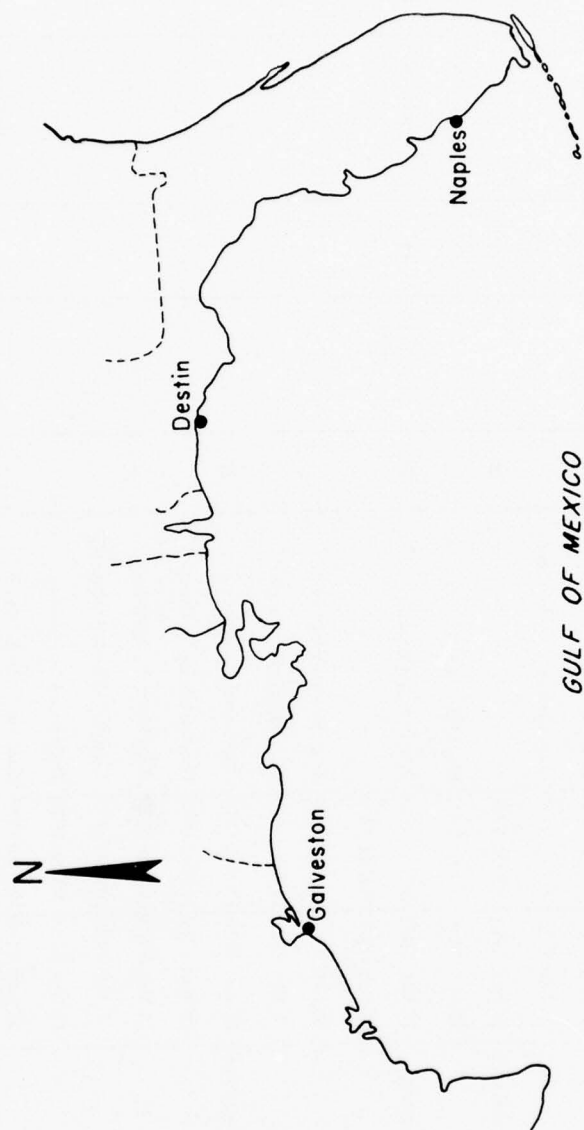


Figure A-63. Location of BEB-CERC wave gages along the U.S. gulf coast.

Table A-39. CERC wave gage history for Municipal Pier, Naples, Florida.

CERC Form 174-74 18 Mar 74		LOCATION: Municipal Pier, Naples, Florida								
COORDINATES: 26°08' N., 81°49' W.		Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance (SR), staff-parallel type	4 June 1957	16 May 1958				20		17	0	900
	15 July 1958	9 Feb. 1959			Lack of funds.					
	8 June 1959	1 Aug. 1960			Gage destroyed by hurricane.					
SR staff-parallel type	24 Oct. 1961	8 Feb. 1966				20		17	0	900
	25 Mar. 1966	6 June 1967			Gage hit by submarine.					
SR staff-relay type	25 Oct. 1967	20 Oct. 1969			Pier being repaired.	15	-4 to +11	17	0	900
	16 Feb. 1970	21 Sept. 1970								
Continuous-wire staff	26 Oct. 1970	2 Aug. 1971			Gage struck by lightning.					
	9 Sept. 1971	17 July 1972			Gage damaged by vandals.					
	25 July 1972	22 Aug. 1972			Gage struck by lightning.	15	-6 to +9	18	0	900
	19 Sept. 1972	16 Mar. 1973			Gage struck by lightning.					
	11 May 1973	20 June 1973			Gage struck by lightning.					
	7 Aug. 1973	20 Aug. 1973			Gage struck by lightning.					
	13 Nov. 1973	8 Dec. 1973			Gage struck by lightning.					
	17 Jan. 1974	19 June 1974			Gage struck by lightning.					
	21 Sept. 1974	18 Mar. 1975			Gage discontinued.					

Table A-40. Number of analyzed records from Naples, Florida.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1957						116	147	186	103	183	177	157	1069
1958	124	138	131	43	93		97	171	186	185	180	186	1534
1959	186	50				132	123	144	112	186	180	164	1277
1960	186	158	184	178	186	176	186	3					1257
1961													
1962	176	139	180	180	183	177	185	185	175	186	180	186	2132
1963	185	163	178	179	184	177	173	185	177	141	180	186	2108
1964	184	174	186	179	186	180	186	186	72	184	177	186	2080
1965	184	168	186	177	176	101	179	185	173	185	172	183	2069
1966	186	43	38	180	159	177	180	164	12	98	178	182	1597
1967	184	167	184	177	83								795
1968											92		92
1969	83	104	98	61	81	60	109	110	102	54			862
1970													
1971			32	94	88	71	56		35	87	75	81	619
1972	84				76	99	53	56		100	114	87	669
1973	89	66	26		64	52		30			37	13	377
1974	31	90	68	58	78	52			14	83	71	85	630
1975	78												

¹Results before November 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the second BEB method for 1957 to March 1964 and analyzed by the CERC method for April 1964 to 1967. Results after November 1968 obtained from 1,024-second digital records taken four times daily.

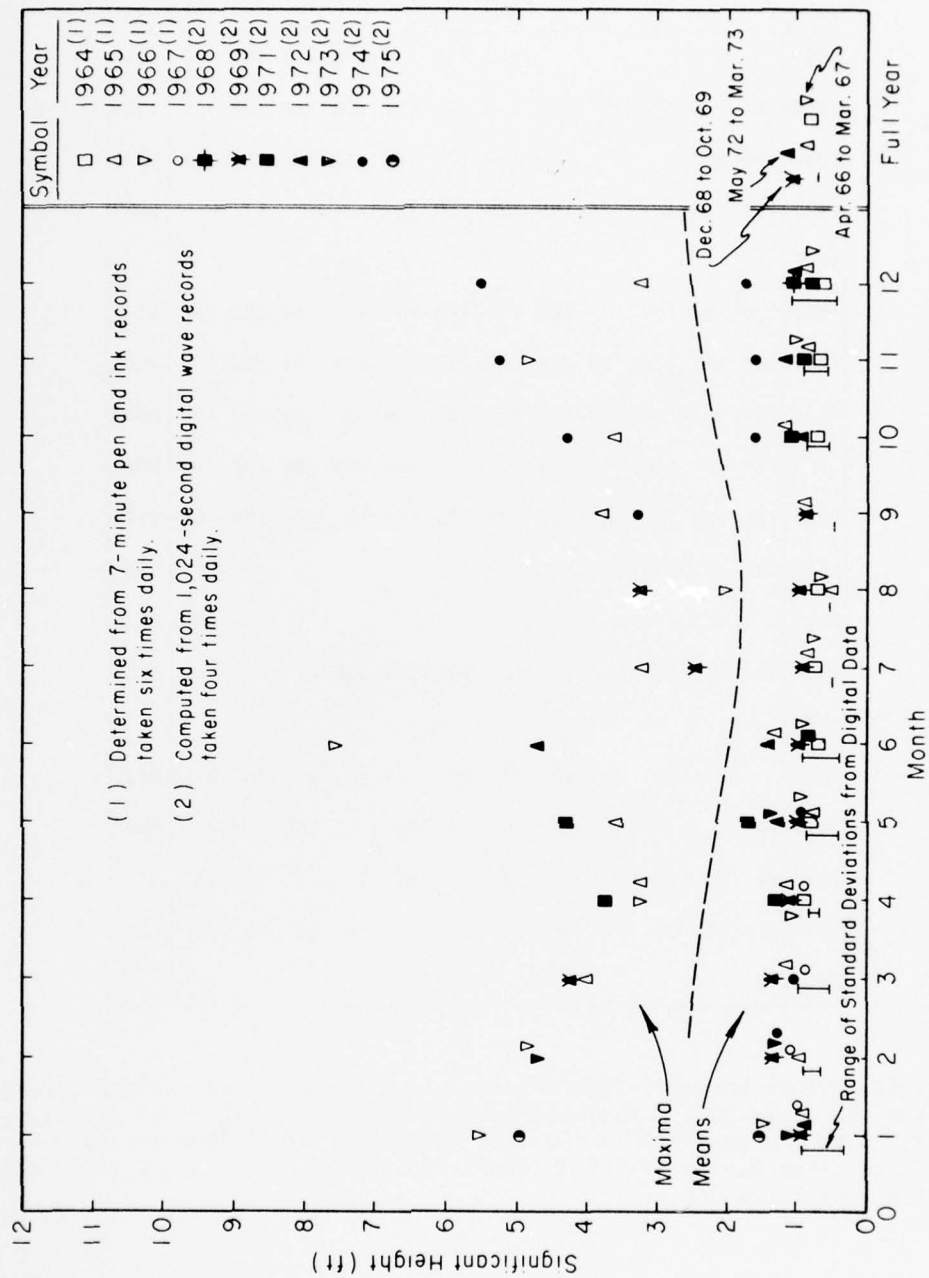


Figure A-64. Maxima, means, and standard deviations of significant height from Naples, Florida.

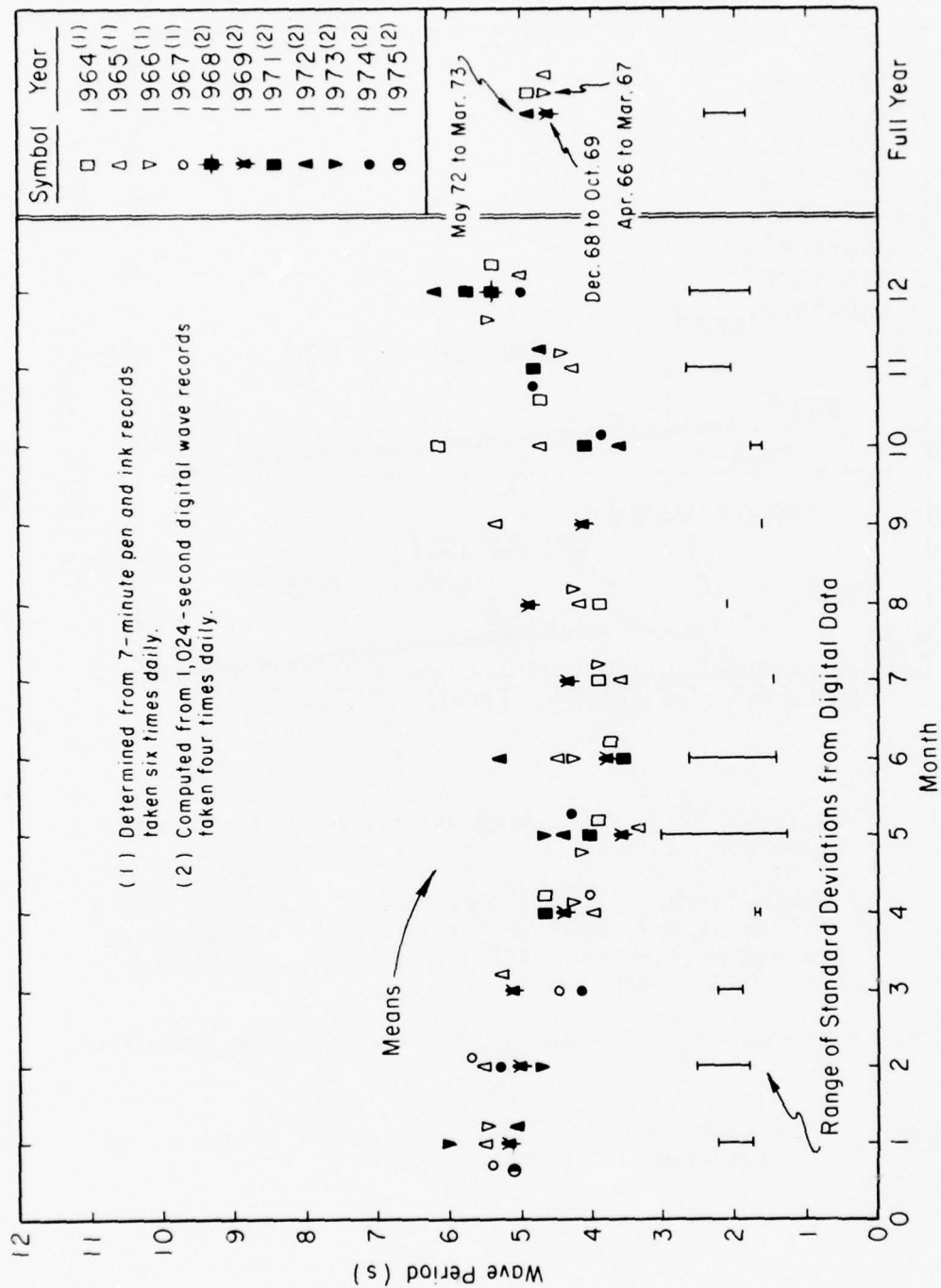
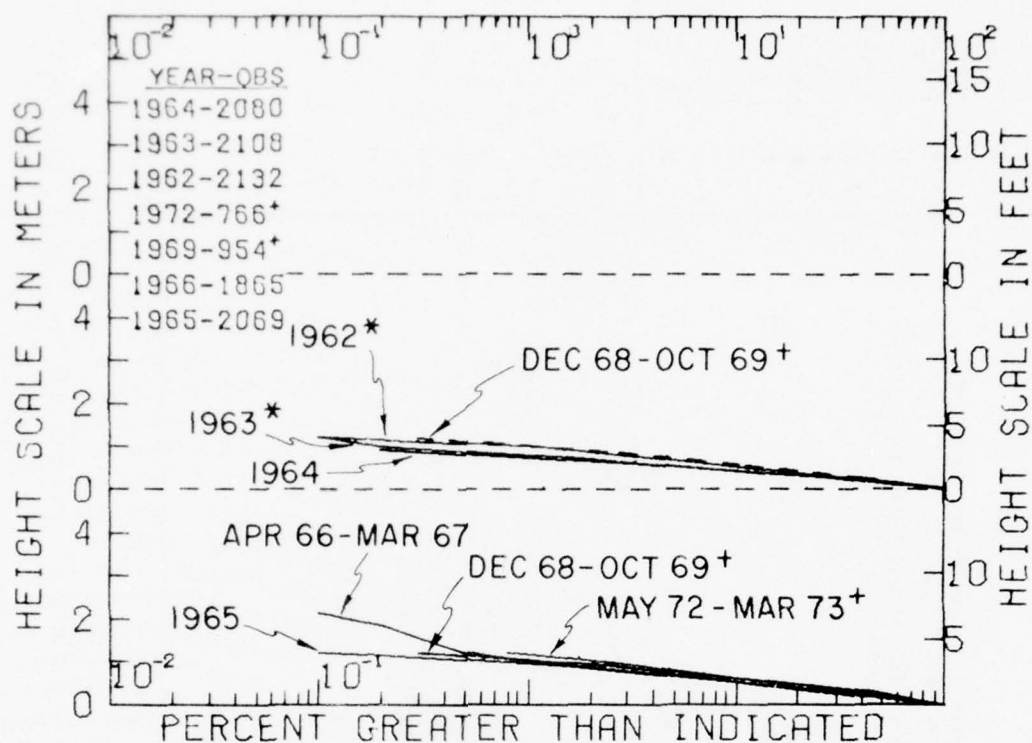


Figure A-65. Means and standard deviations of wave periods for Naples, Florida.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Table A-42).

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-66. Annual cumulative significant height distributions from Naples, Florida.

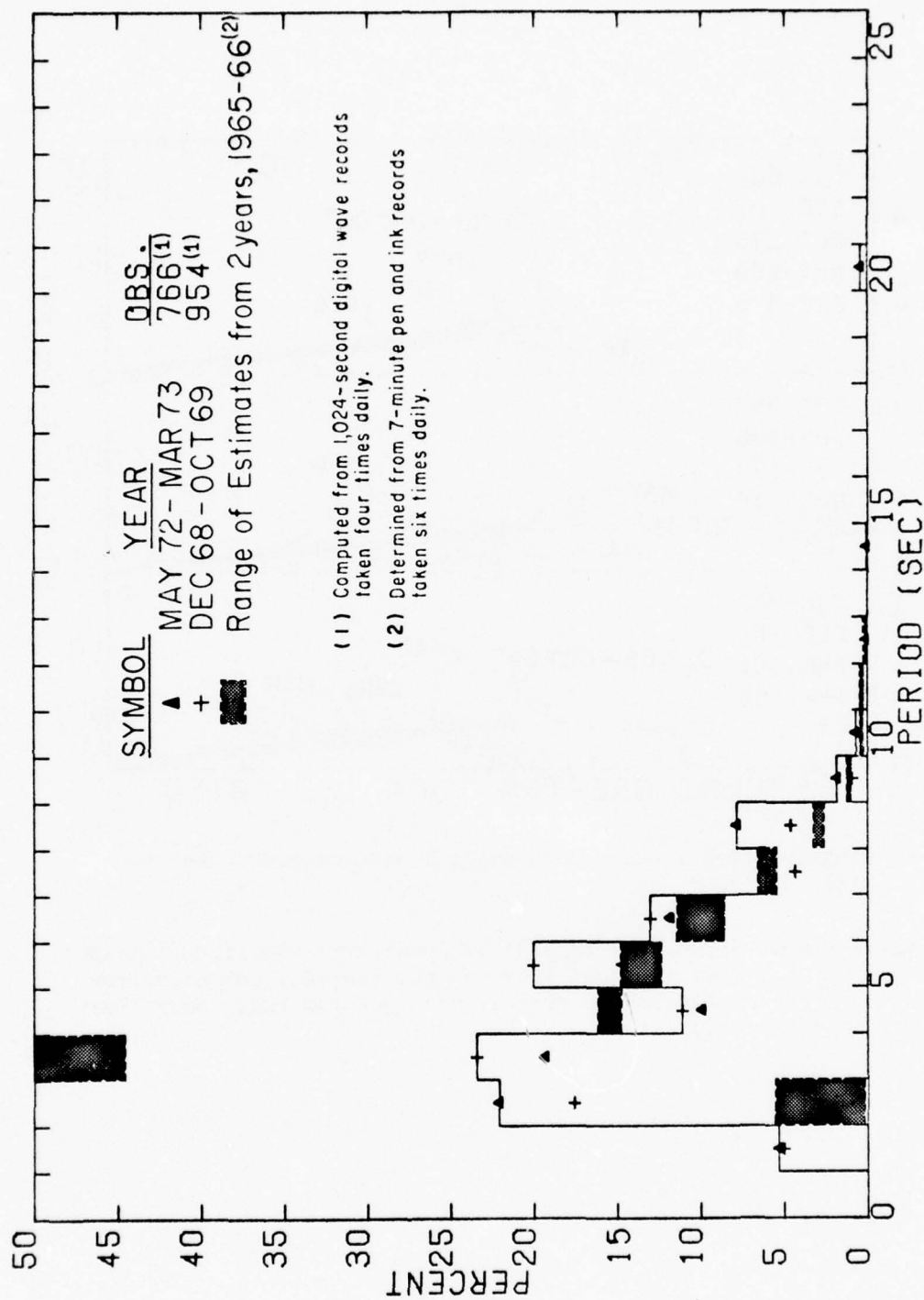
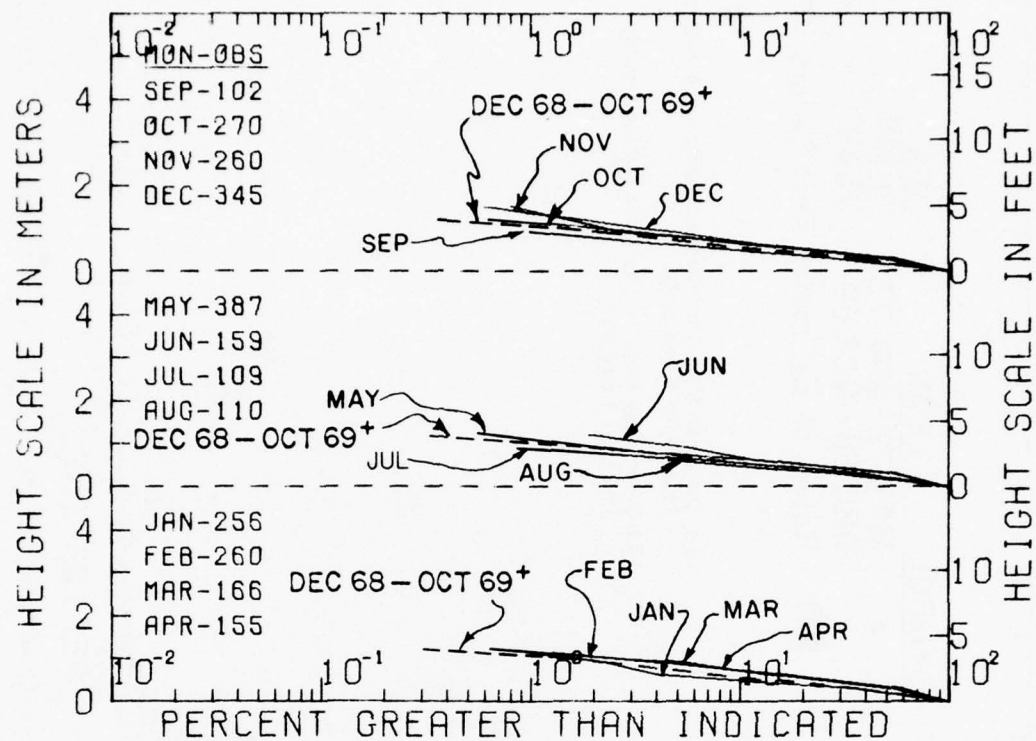


Figure A-67. Annual significant period distributions from Naples, Florida.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Figure A-68. Seasonal summaries of cumulative significant height distributions from Naples, Florida; computed from 1,024-second digital wave records taken four times daily.

Table A-41. Wave climate for Naples, Florida.
Distribution of significant height versus period
(in observations per 1,000 observations).

256 OBSERVATIONS						SUMMARY FOR JAN 69 JAN 72 JAN 73			
PERIOD (SECS)						SIG. HEIGHT (FT)			
	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9	39						1000	0.00	
1.0 - 1.9	35	4				41	1000	.60	
2.0 - 2.9	66	31				102	959	.82	
3.0 - 3.9	55	78	4			142	858	1.13	
4.0 - 4.9	35	35	4	12		89	715	1.41	
5.0 - 5.9	180	55			4	248	626	.80	
6.0 - 6.9	113	55			4	179	378	.91	
7.0 - 7.9	51	23	4			81	199	.90	
8.0 - 8.9	51	27				81	118	.85	
9.0 - 9.9	8	8	4			20	37	1.30	
10.0 - 10.9		4	4	4		12	16	2.50	
11.0 - 11.9							4	0.00	
12.0 - 12.9	4					4	4	.50	
TOTAL	637	320	20	16	8				.94
CUM. TOTAL	1000	363	43	23	8				
COL. AVG.	5.40*	5.29	7.10	6.00	6.00	5.41			

AVERAGE SIG. HEIGHT = .96 FT
 VARIANCE OF SIG. HEIGHT = .39 FT SQ
 STANDARD DEVIATION OF HEIGHT = .63 FT
 AVERAGE WAVE PERIOD = 5.80 SEC*
 VARIANCE OF WAVE PERIOD = 4.29 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.07 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL PIER,
 * CALMS ARE OMITTED.

260 OBSERVATIONS						SUMMARY FOR FEB 69 FEB 73 FEB 74			
PERIOD (SECS)						SIG. HEIGHT (FT)			
	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9							1000	0.00	
1.0 - 1.9	27	4				31	1000	.63	
2.0 - 2.9	69	54	4			127	969	.98	
3.0 - 3.9	46	150	27	4		227	842	1.45	
4.0 - 4.9	62	23	42	12		138	615	1.53	
5.0 - 5.9	81	69	35	12	8	204	477	1.50	
6.0 - 6.9	42	46	8	4		100	273	1.23	
7.0 - 7.9	31	31	8			69	173	1.17	
8.0 - 8.9	15	58	4	4		81	104	1.45	
9.0 - 9.9	4	4				8	23	1.00	
10.0 - 10.9	4					4	15	.50	
11.0 - 11.9							12	0.00	
12.0 - 12.9	8					8	12	.50	
13.0 - 13.9							4	0.00	
14.0 - 14.9							4	0.00	
15.0 - 15.9							4	0.00	
16.0 - 16.9	4					4	4	.50	
TOTAL	392	438	127	35	8			1.33	
CUM. TOTAL	1000	608	169	42	8				
COL. AVG.	5.02*	5.04	4.92	5.39	5.50	5.03			

AVERAGE SIG. HEIGHT = 1.33 FT
 VARIANCE OF SIG. HEIGHT = .59 FT SQ
 STANDARD DEVIATION OF HEIGHT = .77 FT
 AVERAGE WAVE PERIOD = 5.04 SEC*
 VARIANCE OF WAVE PERIOD = 4.59 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.14 SEC*

166 OBSERVATIONS

SUMMARY FOR MAR 69 MAR 74

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9							1000	0.00	
1.0 = 1.9	96					96	1000	.50	
2.0 = 2.9	84	54				139	904	.69	
3.0 = 3.9	84	78	48	6		217	765	1.39	
4.0 = 4.9	18	36	18	18		90	548	1.90	
5.0 = 5.9	66	72	12	18		169	458	1.59	
6.0 = 6.9	66	72	6		6	151	289	1.22	
7.0 = 7.9	30	30	6			66	139	1.14	
8.0 = 8.9	12	42		6		60	72	1.50	
9.0 = 9.9		6	6			12	12	2.00	
TOTAL	458	392	96	48	6				1.25
CUM. TOTAL	1000	542	151	54	6				
COL. AVG.	4.05*	5.32	4.75	5.25	6.50	4.69			

AVERAGE SIG, HEIGHT = 1.25 FT

AVERAGE WAVE PERIOD = 4.72 SEC*

VARIANCE OF SIG, HEIGHT = .68 FT SQ

VARIANCE OF WAVE PERIOD = 4.43 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .83 FT

STANDARD DEVIATION OF PERIOD = 2.11 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES, AND CONT. WIRE

* WAVE GAGE LOCATED AT MUNICIPAL PIER,

* CALMS ARE OMITTED.

155 OBSERVATIONS

SUMMARY FOR APR 69 APR 71

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9						1000	0.00	
1.0 = 1.9	32	6			39	1000	.67	
2.0 = 2.9	77	77			155	961	1.00	
3.0 = 3.9	65	116	84	13	277	806	1.66	
4.0 = 4.9	65	32	19	32	148	529	1.63	
5.0 = 5.9	97	45	6		148	381	.89	
6.0 = 6.9	77	65	19		161	232	1.14	
7.0 = 7.9	19	19			39	71	1.00	
8.0 = 8.9	26		6		32	32	.90	
TOTAL	458	361	135	45				1.27
CUM. TOTAL	1000	542	181	45				
COL. AVG.	4.71*	4.34	4.40	4.21	4.51			

AVERAGE SIG, HEIGHT = 1.24 FT

AVERAGE WAVE PERIOD = 4.55 SEC*

VARIANCE OF SIG, HEIGHT = .56 FT SQ

VARIANCE OF WAVE PERIOD = 2.90 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .75 FT

STANDARD DEVIATION OF PERIOD = 1.70 SEC*

387 OBSERVATIONS

SUMMARY FOR MAY 69 MAY 71 MAY 72 MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9	3						41	1000	0.00
1.0 - 1.9	39	3					241	1000	.56
2.0 - 2.9	93	145	3				326	959	1.12
3.0 - 3.9	106	150	57	13			101	391	1.43
4.0 - 4.9	39	39	21		3		155	290	1.40
5.0 - 5.9	83	57	16				78	135	1.07
6.0 - 6.9	44	26	5		3		26	57	1.10
7.0 - 7.9	18	8					23	31	.80
8.0 - 8.9	3	13	6					8	1.72
9.0 - 9.9									0.00
10.0 - 10.9	3						3	8	.50
11.0 - 11.9								5	0.00
12.0 - 12.9								5	0.00
13.0 - 13.9								5	0.00
14.0 - 14.9								5	0.00
15.0 - 15.9								5	0.00
16.0 - 16.9								5	0.00
17.0 - 17.9								5	0.00
18.0 - 18.9								5	0.00
19.0 - 19.9								5	0.00
20.0 - 20.9	5						5	5	.50
21.0 +									0.00
TOTAL	434	439	109	13	5				1.22
CUM. TOTAL	1000	566	127	18	5				
COL. AVG.	4.33*	3.90	4.45	3.50	5.50	4.15			

AVERAGE SIG. HEIGHT = 1.23 FT

AVERAGE WAVE PERIOD = 4.18 SEC*

VARIANCE OF SIG. HEIGHT = .42 FT SQ

VARIANCE OF WAVE PERIOD = 4.06 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .65 FT

STANDARD DEVIATION OF PERIOD = 2.01 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
WAVE GAGE LOCATED AT MUNICIPAL PIER.

* CALMS ARE OMITTED.

159 OBSERVATIONS

SUMMARY FOR JUN 69 JUN 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9	6						51	1000	0.00
1.0 - 1.9	19	31					158	949	1.13
2.0 - 2.9	69	82	6				310	791	1.10
3.0 - 3.9	94	164	31	19			139	481	1.42
4.0 - 4.9	50	57	13	19			89	342	1.50
5.0 - 5.9	38	38	13				108	253	1.21
6.0 - 6.9	82	6	6		13		51	146	1.15
7.0 - 7.9	38	13					76	95	.75
8.0 - 8.9	50	19						19	1.08
9.0 - 9.9								19	0.00
10.0 - 10.9								19	0.00
11.0 - 11.9								19	0.00
12.0 - 12.9	6						6	19	.50
13.0 - 13.9								13	0.00
14.0 - 14.9	6						6	13	.50
15.0 - 15.9								6	0.00
16.0 - 16.9								6	0.00
17.0 - 17.9								6	0.00
18.0 - 18.9								6	0.00
19.0 - 19.9								6	0.00
20.0 - 20.9	6						6	6	.50
21.0 +									0.00
TOTAL	465	409	69	38	19				1.24
CUM. TOTAL	1000	535	126	57	19				
COL. AVG.	5.46*	3.87	4.23	4.00	7.17	4.70			

AVERAGE SIG. HEIGHT = 1.23 FT

AVERAGE WAVE PERIOD = 4.71 SEC*

VARIANCE OF SIG. HEIGHT = .66 FT SQ

VARIANCE OF WAVE PERIOD = 5.93 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .81 FT

STANDARD DEVIATION OF PERIOD = 2.44 SEC*

109 OBSERVATIONS

SUMMARY FOR JUL 69

PERIOD (SECS)	SIG. HEIGHT (FT)					CUM. TOT. #	ROW TOT. #	AVG. #
	0=1	1=2	2=3	TOT. #				
0.0 = .9						1000	0.00	
1.0 = 1.9	46	9		55		1000	.67	
2.0 = 2.9	92	73		165		945	.94	
3.0 = 3.9	128	64	37	229		780	1.10	
4.0 = 4.9	119	28	9	156		550	.79	
5.0 = 5.9	202	64		266		394	.74	
6.0 = 6.9	101			101		128	.50	
7.0 = 7.9	18			18		28	.50	
8.0 = 8.9	9			9		9	.50	
TOTAL	716	239	46					.83
CUM. TOTAL	1000	284	46					
COL. AVG.	4.56	3.77	3.70	4.33				

AVERAGE SIG. HEIGHT = .90 FT

VARIANCE OF SIG. HEIGHT = .23 FT SQ

STANDARD DEVIATION OF HEIGHT = .48 FT

AVERAGE WAVE PERIOD = 4.37 SEC

VARIANCE OF WAVE PERIOD = 2.19 SEC SQ

STANDARD DEVIATION OF PERIOD = 1.48 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL PIER.
 * CALMS ARE OMITTED.

110 OBSERVATIONS

SUMMARY FOR AUG 69

PERIOD (SECS)	SIG. HEIGHT (FT)					CUM. TOT. #	ROW TOT. #	AVG. #
	0=1	1=2	2=3	3=4	TOT. #			
0.0 = .9						1000	0.00	
1.0 = 1.9	64				64	1000	.50	
2.0 = 2.9	100	45			145	936	.81	
3.0 = 3.9	118	45	9		173	791	.87	
4.0 = 4.9	55	64	18		136	618	1.23	
5.0 = 5.9	173	73	9		255	482	.86	
6.0 = 6.9	73	9			82	227	.61	
7.0 = 7.9	9	18			27	145	1.17	
8.0 = 8.9	18	45	9		73	118	1.18	
9.0 = 9.9		18	18	9	45	45	2.30	
TOTAL	609	318	64	9				.97
CUM. TOTAL	1000	391	73	9				
COL. AVG.	4.35	5.39	6.50	9.50	4.86			

AVERAGE SIG. HEIGHT = .97 FT

VARIANCE OF SIG. HEIGHT = .31 FT SQ

STANDARD DEVIATION OF HEIGHT = .56 FT

AVERAGE WAVE PERIOD = 4.87 SEC

VARIANCE OF WAVE PERIOD = 4.39 SEC SQ

STANDARD DEVIATION OF PERIOD = 2.10 SEC

102 OBSERVATIONS

SUMMARY FOR SEP 69

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9						1000	0.00
1.0 - 1.9	49				49	1000	.50
2.0 - 2.9	157	69			225	951	.80
3.0 - 3.9	147	98	20	10	275	725	1.11
4.0 - 4.9	98	39	20		157	451	1.00
5.0 - 5.9	167	10			176	294	.56
6.0 - 6.9	69				69	118	.50
7.0 - 7.9	20				20	49	.50
8.0 - 8.9	20				20	29	.50
9.0 - 9.9	10				10	10	.50
TOTAL	735	216	39	10			.82
CUM. TOTAL	1000	265	49	10			
COL. AVG.	4.34*	3.45	4.00	3.50	4.13		

AVERAGE SIG. HEIGHT = .84 FT AVERAGE WAVE PERIOD = 4.14 SEC*
 VARIANCE OF SIG. HEIGHT = .23 FT SQ VARIANCE OF WAVE PERIOD = 2.68 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .48 FT STANDARD DEVIATION OF PERIOD = 1.64 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL PIER.
 * CALMS ARE OMITTED.

270 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 72 OCT 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9	15						1000	0.00
1.0 - 1.9	74	7				83	1000	.59
2.0 - 2.9	189	133	7			335	917	.95
3.0 - 3.9	56	104	30	7	4	203	583	1.50
4.0 - 4.9	33	30	11	15	4	94	380	1.70
5.0 - 5.9	52	70	22	4		150	286	1.35
6.0 - 6.9	48	30	7			86	135	1.02
7.0 - 7.9	11	7				19	49	.90
8.0 - 8.9	15	11	4			30	30	1.13
TOTAL	493	393	81	26	7			1.16
CUM. TOTAL	1000	507	115	33	7			
COL. AVG.	3.63*	4.00	4.59	4.36	4.00	3.88		

AVERAGE SIG. HEIGHT = 1.17 FT AVERAGE WAVE PERIOD = 3.88 SEC*
 VARIANCE OF SIG. HEIGHT = .51 FT SQ VARIANCE OF WAVE PERIOD = 2.94 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .71 FT STANDARD DEVIATION OF PERIOD = 1.72 SEC*

260 OBSERVATIONS

SUMMARY FOR NOV 71 NOV 72 NOV 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9	42							1000	1000	0.00
1.0 - 1.9	50	12						64	1000	.64
2.0 - 2.9	135	85	8					237	916	.94
3.0 - 3.9	46	92	27	4				177	699	1.43
4.0 - 4.9	31	15	12			8		68	522	1.68
5.0 - 5.9	50	85	15	8				165	454	1.38
6.0 - 6.9	38	50	12	8				112	289	1.39
7.0 - 7.9	23	19	8					52	177	1.19
8.0 - 8.9	38	31	15					88	124	1.23
9.0 - 9.9		15	8					24	36	1.83
10.0 - 10.9		4						4	12	1.50
11.0 - 11.9									8	0.00
12.0 - 12.9		4						4	8	1.50
13.0 - 13.9									4	0.00
14.0 - 14.9		4						4	4	1.50
TOTAL	454	415	104	19		8				1.22
CUM. TOTAL	1000	545	131	27	8	8				
COL. AVG.	4.22*	5.07	5.65	5.50	0.00	4.50	4.77			

AVERAGE SIG. HEIGHT = 1.22 FT

AVERAGE WAVE PERIOD = 4.74 SEC*

VARIANCE OF SIG. HEIGHT = .58 FT SQ

VARIANCE OF WAVE PERIOD = 5.53 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .76 FT

STANDARD DEVIATION OF PERIOD = 2.35 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
 WAVE GAGE LOCATED AT MUNICIPAL PIER.

* CALMS ARE OMITTED.

345 OBSERVATIONS

SUMMARY FOR DEC 68 DEC 71 DEC 72 DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 - .9	58							1000	1000	0.00
1.0 - 1.9	29	9						40	1000	.73
2.0 - 2.9	64	52	6					129	960	1.02
3.0 - 3.9	26	58	12	3				105	831	1.41
4.0 - 4.9	29	9	23	9				74	726	1.67
5.0 - 5.9	104	78	20	9	12	6		243	652	1.46
6.0 - 6.9	122	49	6	3				191	409	.89
7.0 - 7.9	58	29						92	218	.83
8.0 - 8.9	38	38	12	6				98	126	1.34
9.0 - 9.9		6	9	3				18	28	2.33
10.0 - 10.9			3					3	9	2.50
11.0 - 11.9									6	0.00
12.0 - 12.9									6	0.00
13.0 - 13.9									6	0.00
14.0 - 14.9									6	0.00
15.0 - 15.9									6	0.00
16.0 - 16.9	6							6	6	.50
TOTAL	533	328	90	32	12	6				1.18
CUM. TOTAL	1000	467	139	49	17	6				
COL. AVG.	5.55*	5.28	5.79	6.05	5.50	5.50	5.50			

AVERAGE SIG. HEIGHT = 1.19 FT

AVERAGE WAVE PERIOD = 5.54 SEC*

VARIANCE OF SIG. HEIGHT = .75 FT SQ

VARIANCE OF WAVE PERIOD = 4.83 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .86 FT

STANDARD DEVIATION OF PERIOD = 2.20 SEC*

2579 OBSERVATIONS

SUMMARY FOR 30 MONTHS DEC 68 THROUGH DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	RD- TOT.*	AVG.*
0.0 - .9	18							53	1000	0.00
1.0 - 1.9	45	7						186	1000	.64
2.0 - 2.9	98	81	3					218	762	1.38
3.0 - 3.9	71	104	32	7				107	544	1.47
4.0 - 4.9	45	31	18	9	1	1		187	437	1.16
5.0 - 5.9	98	63	15	5	3	1		121	250	1.03
6.0 - 6.9	71	38	6	2	2			51	128	.95
7.0 - 7.9	29	18	2					59	78	1.25
8.0 - 8.9	25	26	6	2				11	19	1.83
9.0 - 9.9	2	5	3	1				3	8	1.79
10.0 - 10.9	1	1	1						5	0.00
11.0 - 11.9								2	5	.70
12.0 - 12.9	2								3	0.00
13.0 - 13.9								1	3	1.00
14.0 - 14.9									2	0.00
15.0 - 15.9								1	2	.50
16.0 - 16.9	1								1	0.00
17.0 - 17.9									1	0.00
18.0 - 18.9									1	0.00
19.0 - 19.9									1	0.00
20.0 - 20.9	1							1	1	.50
21.0 +										0.00
TOTAL	508	373	87	25	6	2				1.15
CUM. TOTAL	1000	492	119	31	8	2				
COL. AVG.	4.68*	4.02	4.97	5.05	5.75	5.00	4.70			

AVERAGE SIG. HEIGHT = 1.16 FT

AVERAGE WAVE PERIOD = 4.71 SEC*

VARIANCE OF SIG. HEIGHT = .54 FT SQ

VARIANCE OF WAVE PERIOD = 4.49 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .74 FT

STANDARD DEVIATION OF PERIOD = 2.12 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A STEP RES. AND CONT. WIRE
WAVE GAGE LOCATED AT MUNICIPAL PIER.

* CALMS ARE OMITTED.

5837 OBSERVATIONS

SUMMARY FOR 33 months Mar 64 through Apr 67

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.*	CUM. TOT.*	RD- TOT.*	AVG.*
0.0 - .9	291									1000	0.00	
1.0 - 1.9	1								1	1000	.50	
2.0 - 2.9	25	5							43	949	.66	
3.0 - 3.9	223	93	9						459	957	.84	
4.0 - 4.9	53	38	18	2	1				157	498	1.24	
5.0 - 5.9	50	28	8	1					127	341	1.13	
6.0 - 6.9	41	25	6	2	1				106	214	1.11	
7.0 - 7.9	22	15	4	1	1				62	108	1.18	
8.0 - 8.9	10	7	2	1					28	47	1.24	
9.0 - 9.9	4	4	1						13	18	1.25	
10.0 - 10.9	1	1							3	6	1.33	
11.0 - 11.9	1	1							2	3	.93	
12.0 - 12.9									1	1	1.50	
TOTAL	722	217	48	11	2	1					.85	
CUM. TOTAL	1000	278	61	12	3	1						
COL. AVG.	4.49*	3.88	5.29	5.49	6.32	6.83	6.50	7.50	4.69			

AVERAGE SIG. HEIGHT = .83 FT

AVERAGE WAVE PERIOD = 4.28 SEC*

VARIANCE OF SIG. HEIGHT = .32 FT SQ

VARIANCE OF WAVE PERIOD = 2.58 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .57 FT

STANDARD DEVIATION OF PERIOD = 1.61 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP-RESISTANCE
WAVE GAGE LOCATED AT MUNICIPAL PIER.

* CALMS ARE OMITTED.

Table A-42. Regression equations used to compensate significant height statistics for Naples, Florida.

Date	Compensation equations (ft)
1960 to Mar. 1964	$H_{NEW} = 0.23 + 0.76 H_{OLD}$
Apr. 1964 to 1974	No compensation

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis (based on reanalysis of 2 months of data from Atlantic City, New Jersey).

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

Table A-43. CERC wave gage history for Crystal Pier, Destin, Florida.

CERC Form 174-74

15 Mar 74

COORDINATES: 30°23' N., 86°25' W.

LOCATION: Crystal Pier, Destin, Florida

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Continuous-wire staff	17 June 1971	21 June 1971	Gage struck by lightning.	20	-5 to +15	11	0	600
	20 July 1971	1 Aug. 1971	Gage struck by lightning.					
	11 Sept. 1971	6 Feb. 1972	Gage struck by lightning.					
	7 Mar. 1972	18 July 1972	Gage struck by lightning.					
	27 July 1972	22 Aug. 1972	Gage struck by lightning.					
	30 Aug. 1972	9 Sept. 1972	Gage struck by lightning.					
	20 Sept. 1972	23 Oct. 1972	Gage struck by lightning.					
	21 Nov. 1972	5 Dec. 1972	Signal cable loose.					
Continuous-wire staff	17 Jan. 1973	30 Mar. 1973	Fuse blown.	20	-8 to +12	11	0	600
	18 Apr. 1973	31 July 1973	Gage struck by lightning.					
	16 Jan. 1974	7 Aug. 1974	Gage struck by lightning.					
		Gage discontinued.						

Table A-44. Number of analyzed digital records from Destin, Florida.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1971							36		76	113	83	104	412
1972	99		87	109	112	115	66	68	58	72	35	18	839
1973	44	70	109	8	92	79	53						455
1974	56	100	87	25	96	64	64	18					510

¹From 1,024-second records taken four times daily.

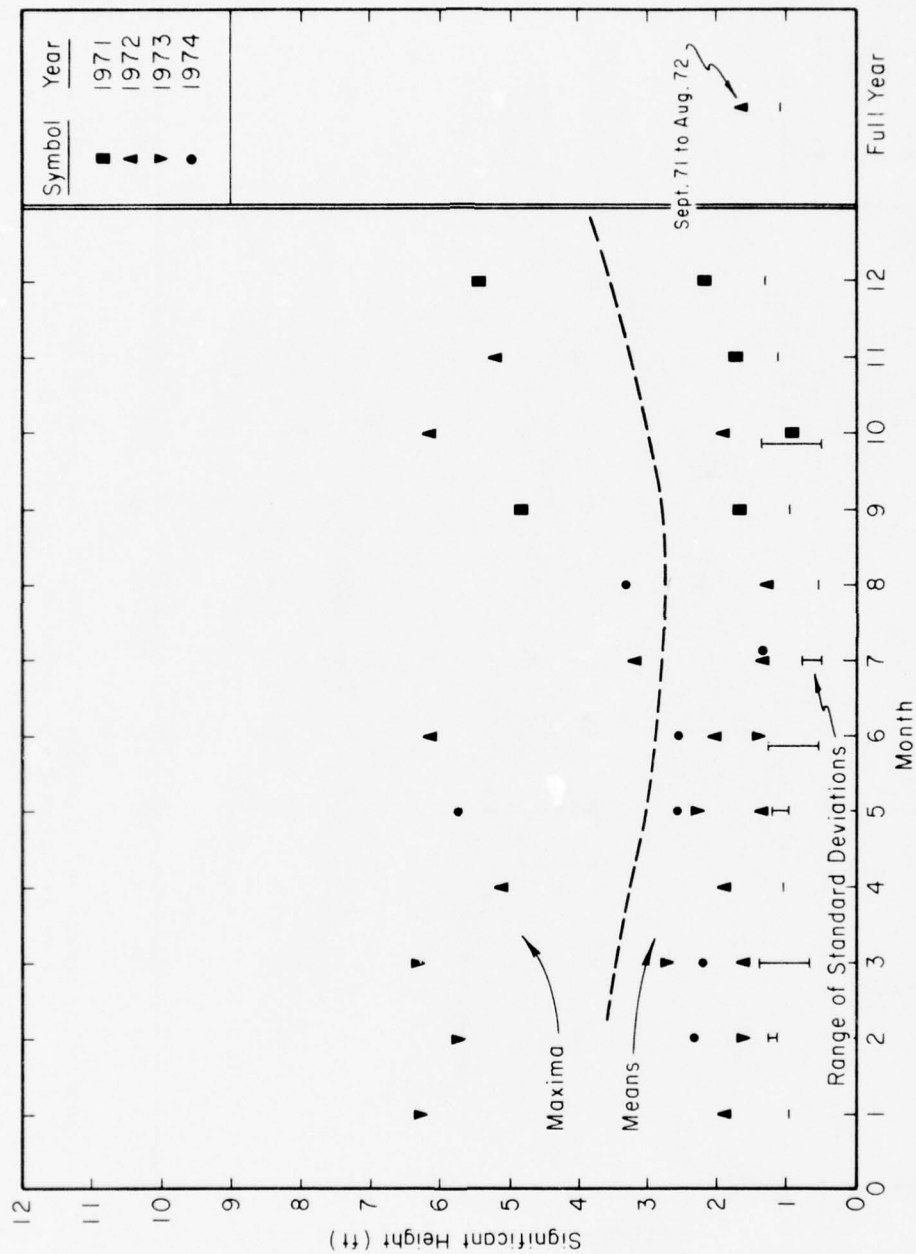


Figure A-69. Maxima, means, and standard deviations of significant height from Destin, Florida; computed from 1,024-second digital wave records taken four times daily.

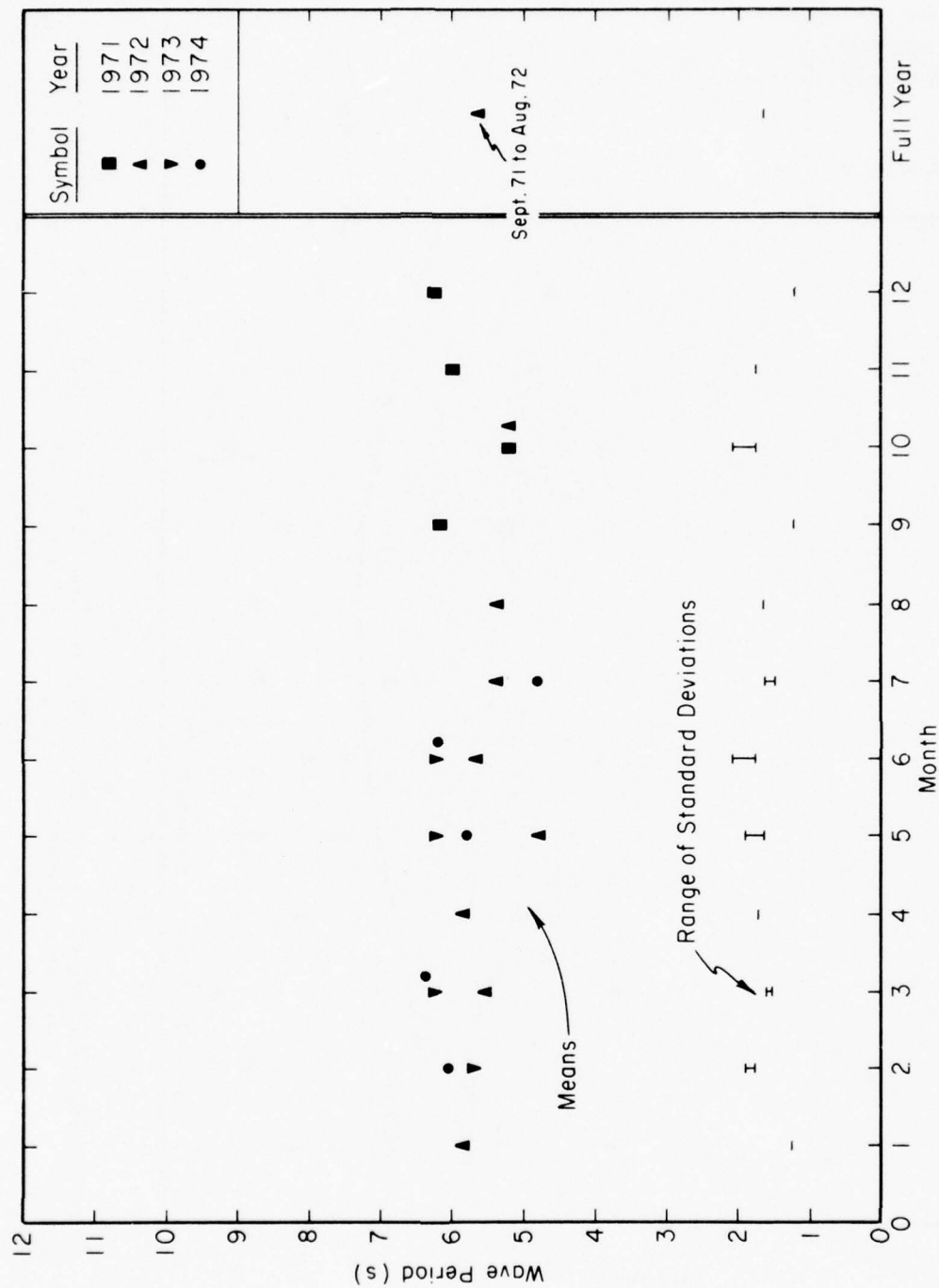
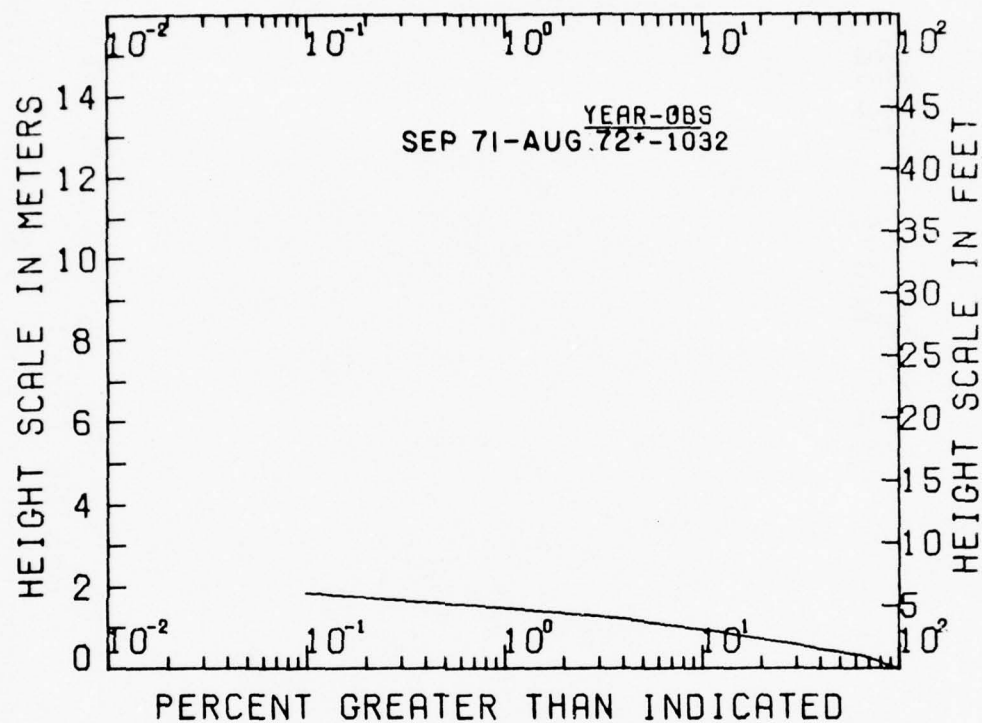


Figure A-70. Means and standard deviations of wave periods for Destin, Florida; computed from 1,024-second digital wave records taken four times daily.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Figure A-71. Annual cumulative significant height distribution from Destin, Florida.

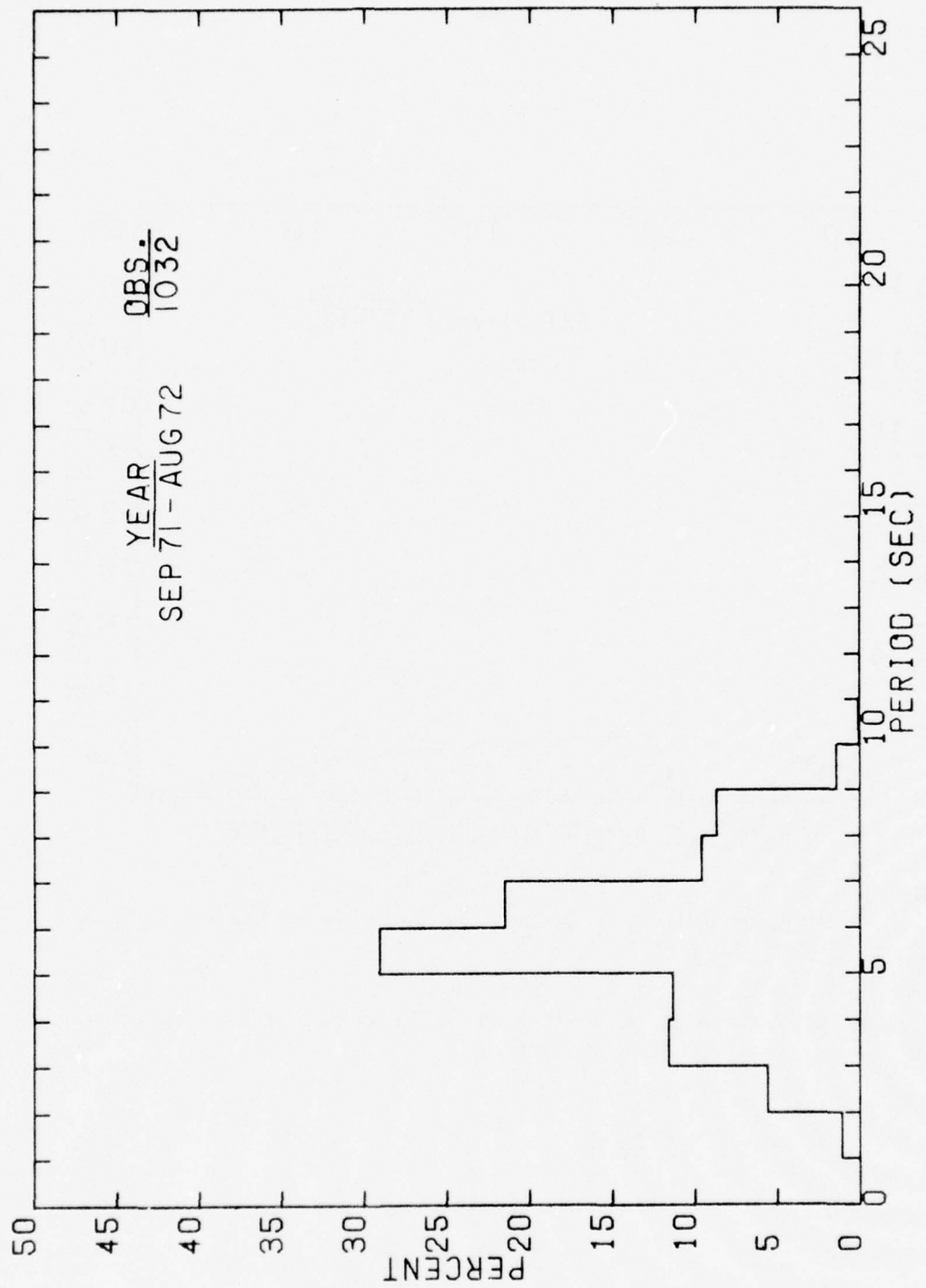


Figure A-72. Annual significant period distributions from Destin, Florida; computed from 1,024-second digital wave records taken four times daily.

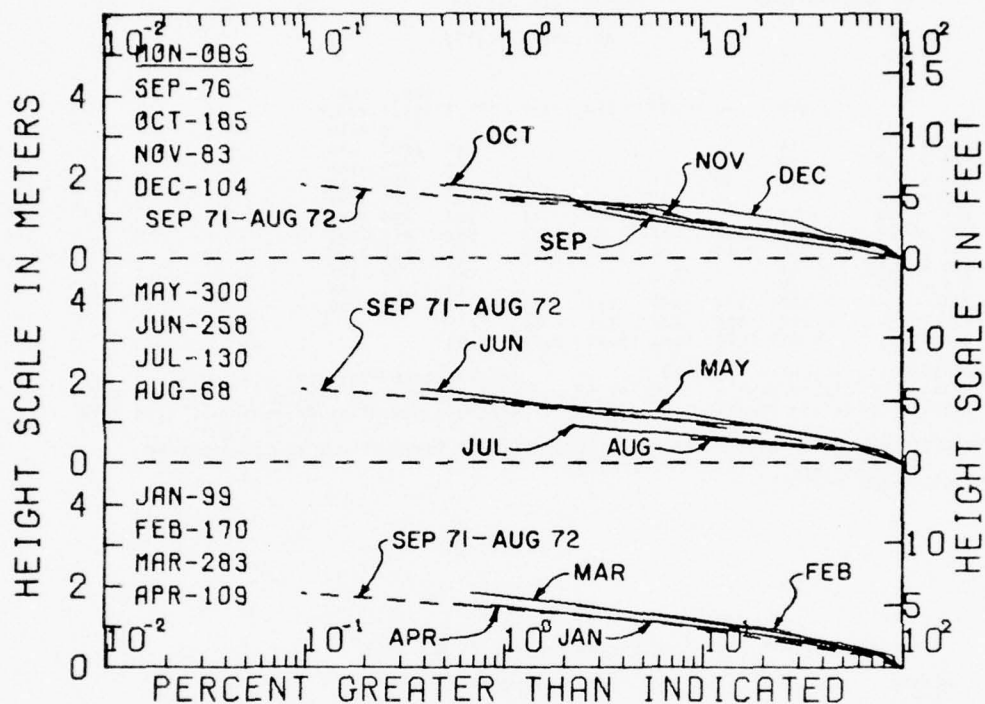


Figure A-73. Seasonal summaries of cumulative significant height distributions from Destin, Florida; computed from 1,024-second digital wave records taken four times daily.

Table A-45. Wave climate for Destin, Florida.
Distribution of significant height versus period
(in observations per 1,000 observations).

99 OBSERVATIONS		SUMMARY FOR JAN 72									
PERIOD (SECS)		SIG. HEIGHT (FT)									
		0=1	1=2	2=3	3=4	4=5	TOT, *	CUM. TOT, *	ROW TOT, *	AVG, *	
0.0 = .9								1000	0.00		
1.0 = 1.9	10						10	1000	.50		
2.0 = 2.9	10						10	990	.50		
3.0 = 3.9	10		30	10			51	980	1.50		
4.0 = 4.9			61	30			91	929	1.83		
5.0 = 5.9	51		91	162	30	10	343	838	2.09		
6.0 = 6.9	51		172	61	51	20	354	495	1.99		
7.0 = 7.9	10		40	10	20	10	91	141	2.28		
8.0 = 8.9	40						40	51	.50		
9.0 = 9.9	10						10	10	.50		
TOTAL	192	394	273	101	40					1.90	
CUM. TOTAL	1000	808	414	141	40						
COL. AVG.	6.24*	5.83	5.61	6.40	6.50	5.93					

AVERAGE SIG. HEIGHT = 1.86 FT
 VARIANCE OF SIG. HEIGHT = .98 FT SQ
 STANDARD DEVIATION OF HEIGHT = .99 FT
 AVERAGE WAVE PERIOD = 5.86 SEC*
 VARIANCE OF WAVE PERIOD = 1.63 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.28 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT CRYSTAL PIER,
 * CALMS ARE OMITTED.

170 OBSERVATIONS		SUMMARY FOR FEB 73 FEB 74									
PERIOD (SECS)		SIG. HEIGHT (FT)									
		0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM. TOT, *	ROW TOT, *	AVG, *
0.0 = .9									1000	0.00	
1.0 = 1.9									1000	0.00	
2.0 = 2.9	29	6						35	1000	.67	
3.0 = 3.9	47	76	12					135	965	1.24	
4.0 = 4.9		82	59	6				147	829	1.98	
5.0 = 5.9	35	47	88	53	29			253	682	2.48	
6.0 = 6.9	35	53	6	53	6	6		199	429	2.24	
7.0 = 7.9	18	24	6	18	12			76	271	2.27	
8.0 = 8.9	59	24	6	35	18	18		159	194	2.39	
9.0 = 9.9	18	6	6	6				35	35	1.50	
TOTAL	241	318	182	171	65	24				2.07	
CUM. TOTAL	1000	759	441	259	88	24					
COL. AVG.	6.06*	5.31	5.37	6.74	6.77	8.00	5.91				

AVERAGE SIG. HEIGHT = 2.05 FT
 VARIANCE OF SIG. HEIGHT = 1.53 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.24 FT
 AVERAGE WAVE PERIOD = 5.91 SEC*
 VARIANCE OF WAVE PERIOD = 3.33 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.82 SEC*

283 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 73 MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9									1000	0.00	
1.0 = 1.9	4							4	1000	0.50	
2.0 = 2.9	4	25						28	996	1.38	
3.0 = 3.9	7	53	7	4				71	968	1.60	
4.0 = 4.9	7	60	42	11				120	898	1.97	
5.0 = 5.9	25	95	81	67	11			279	777	2.30	
6.0 = 6.9	35	88	102	18	18	7		269	498	2.18	
7.0 = 7.9	7	39	21	14	7		4	92	230	2.38	
8.0 = 8.9	7	28	35	25	11		4	110	138	2.66	
9.0 = 9.9	4	4			4	11		21	28	3.83	
10.0 = 10.9	4	4						7	7	1.00	
TOTAL	102	396	290	138	49	18	7				2.22
CUM. TOTAL	1000	898	502	212	74	25	7				
COL. AVG.	6.05*	5.61	6.17	6.24	7.07	8.30	8.00	6.04			

AVERAGE SIG. HEIGHT = 2.21 FT AVERAGE WAVE PERIOD = 6.10 SEC*
 VARIANCE OF SIG. HEIGHT = 1.24 FT SQ VARIANCE OF WAVE PERIOD = 2.58 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.11 FT STANDARD DEVIATION OF PERIOD = 1.61 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT CRYSTAL PIER.
 * CALMS ARE OMITTED.

109 OBSERVATIONS

SUMMARY FOR APR 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM. TOT.*	ROW TOT.*	AVG.*
0.0 = .9								1000	0.00	
1.0 = 1.9								1000	0.00	
2.0 = 2.9	37	18					55	1000	.83	
3.0 = 3.9	46	83					128	945	1.14	
4.0 = 4.9	9	37	18	9			73	817	1.88	
5.0 = 5.9	18	174	73	18			284	743	1.82	
6.0 = 6.9	37	73	64	55			229	459	2.10	
7.0 = 7.9	9	28	18	18	9	9	92	229	2.70	
8.0 = 8.9	37	37	9	18	18		119	138	2.04	
9.0 = 9.9		18					18	18	1.50	
TOTAL	193	468	183	119	28	9				1.85
CUM. TOTAL	1000	807	339	156	37	9				
COL. AVG.	5.26*	5.62	6.10	6.65	8.17	7.50	5.85			

AVERAGE SIG. HEIGHT = 1.84 FT AVERAGE WAVE PERIOD = 5.86 SEC*
 VARIANCE OF SIG. HEIGHT = 1.03 FT SQ VARIANCE OF WAVE PERIOD = 2.94 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.01 FT STANDARD DEVIATION OF PERIOD = 1.72 SEC*

300 OBSERVATIONS

SUMMARY FOR MAY 72 MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM.*	ROW
0.0 = .9	13							1000	0.00
1.0 = 1.9	13						14	1000	.50
2.0 = 2.9	43	33	3				81	986	1.00
3.0 = 3.9	47	60	30				139	905	1.38
4.0 = 4.9	50	43	40				135	767	1.43
5.0 = 5.9	40	73	70	47	23	3	260	632	2.31
6.0 = 6.9	7	37	57	37	13		152	372	2.59
7.0 = 7.9	23	7	33	20	13		98	220	2.43
8.0 = 8.9	30	10	23	17	17	3	101	122	2.40
9.0 = 9.9	3		3	3	3		14	20	2.75
10.0 = 10.9					3		3	7	4.50
11.0 = 11.9								3	0.00
12.0 = 12.9					3		3	1	4.50
TOTAL	270	263	260	123	77	7			1.99
CUM. TOTAL	1000	730	467	207	83	7			
COL. AVG.	4.84*	4.80	5.87	6.64	7.37	7.00	5.54		

AVERAGE SIG. HEIGHT = 2.00 FT

AVERAGE WAVE PERIOD = 5.56 SEC*

VARIANCE OF SIG. HEIGHT = 1.44 FT SQ

VARIANCE OF WAVE PERIOD = 3.57 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.20 FT

STANDARD DEVIATION OF PERIOD = 1.89 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
WAVE GAGE LOCATED AT CRYSTAL PIER,

* CALMS ARE OMITTED.

258 OBSERVATIONS

SUMMARY FOR JUN 72 JUN 73 JUN 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM.*	ROW
0.0 = .9	4								1000	0.00
1.0 = 1.9		4						4	1000	1.50
2.0 = 2.9	31	16	4					51	996	1.96
3.0 = 3.9	27	66	12					105	946	1.35
4.0 = 4.9	8	39	35					82	840	1.83
5.0 = 5.9	50	136	109	58	4			358	759	2.02
6.0 = 6.9	23	19	35	50	8			136	401	2.50
7.0 = 7.9	19	8	12	27				66	265	2.21
8.0 = 8.9	43	47	19	19	4			132	198	1.71
9.0 = 9.9	4	23	19		4	4	4	58	66	2.97
10.0 = 10.9				4		4		8	8	4.50
TOTAL	209	357	244	159	19	8	4			1.96
CUM. TOTAL	1000	791	434	190	31	12	4			
COL. AVG.	5.75*	5.60	6.01	6.65	7.30	10.00	9.50	5.98		

AVERAGE SIG. HEIGHT = 1.95 FT

AVERAGE WAVE PERIOD = 5.99 SEC*

VARIANCE OF SIG. HEIGHT = 1.07 FT SQ

VARIANCE OF WAVE PERIOD = 3.63 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.04 FT

STANDARD DEVIATION OF PERIOD = 1.91 SEC*

130 OBSERVATIONS

SUMMARY FOR JUL 72 JUL 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT. #	CUM. TOT. #	ROW AVG. #
0.0 - .9	8					1000	0.00
1.0 - 1.9						1000	0.00
2.0 - 2.9	23	38			62	1000	1.13
3.0 - 3.9	54	115	15		186	938	1.29
4.0 - 4.9	31	169	38	8	248	752	1.59
5.0 - 5.9	77	169	46		295	504	1.39
6.0 - 6.9	31	31		8	70	209	1.28
7.0 - 7.9	23	31			54	140	1.07
8.0 - 8.9	38	23	8	8	78	85	1.30
9.0 - 9.9	8				8	8	1.50
TOTAL	292	577	108	23			1.36
CUM. TOTAL	1000	708	131	23			
COL. AVG.	5.55*	4.89	5.07	6.50	5.14		

AVERAGE SIG. HEIGHT = 1.33 FT

AVERAGE WAVE PERIOD = 5.13 SEC*

VARIANCE OF SIG. HEIGHT = .38 FT SQ

VARIANCE OF WAVE PERIOD = 2.48 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .61 FT

STANDARD DEVIATION OF PERIOD = 1.57 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

* WAVE GAGE LOCATED AT CRYSTAL PIER,

* CALMS ARE OMITTED.

68 OBSERVATIONS

SUMMARY FOR AUG 72

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	TOT. #	CUM. TOT. #	ROW AVG. #
0.0 - .9					1000	0.00
1.0 - 1.9	15			15	1000	1.50
2.0 - 2.9		44		44	985	1.50
3.0 - 3.9	59	132		191	941	1.19
4.0 - 4.9	44	59	15	118	750	1.25
5.0 - 5.9	103	191	44	338	632	1.33
6.0 - 6.9	74	29	29	132	294	1.17
7.0 - 7.9	15	44		59	162	1.25
8.0 - 8.9	74	29		103	103	1.79
TOTAL	382	529	88			1.21
CUM. TOTAL	1000	618	88			
COL. AVG.	5.77*	5.03	5.67	5.37		

AVERAGE SIG. HEIGHT = 1.24 FT

AVERAGE WAVE PERIOD = 5.18 SEC*

VARIANCE OF SIG. HEIGHT = .25 FT SQ

VARIANCE OF WAVE PERIOD = 2.65 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .50 FT

STANDARD DEVIATION OF PERIOD = 1.63 SEC*

76 OBSERVATIONS

SUMMARY FOR SEP 71

PERIOD (SECS)	SIG. HEIGHT (FT)					CUM. TOT. #	ROW TOT. #	AVG. #
	0=1	1=2	2=3	3=4	4=5			
0.0 = .9							1000	0.00
1.0 = 1.9	13					13	1000	.50
2.0 = 2.9							987	0.00
3.0 = 3.9	13	13				26	987	1.00
4.0 = 4.9	39	66	13			118	961	1.28
5.0 = 5.9	66	66	53			184	842	1.43
6.0 = 6.9	79	171	158		26	434	658	1.86
7.0 = 7.9	13	39	26	39		118	224	2.28
8.0 = 8.9		53	26		13	92	105	2.21
9.0 = 9.9		13				13	13	1.50
TOTAL	224	421	276	39	39			1.75
CUM. TOTAL	1000	776	355	79	39			
COL. AVG.	5.44*	6.38	6.50	7.50	7.17	6.28		

AVERAGE SIG. HEIGHT = 1.63 FT
 VARIANCE OF SIG. HEIGHT = .85 FT SQ
 STANDARD DEVIATION OF HEIGHT = .92 FT

AVERAGE WAVE PERIOD = 6.17 SEC*
 VARIANCE OF WAVE PERIOD = 1.62 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.27 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT CRYSTAL PIER.
 * CALMS ARE OMITTED.

185 OBSERVATIONS

SUMMARY FOR OCT 71 OCT 72

PERIOD (SECS)	SIG. HEIGHT (FT)							CUM. TOT. #	ROW TOT. #	AVG. #
	0=1	1=2	2=3	3=4	4=5	5=6	6=7			
0.0 = .9	70								1000	0.00
1.0 = 1.9	27							29	1000	.50
2.0 = 2.9	86	16						110	971	.66
3.0 = 3.9	81	65	11					169	860	1.05
4.0 = 4.9	27	70	27	5				140	692	1.38
5.0 = 5.9	43	81	43	27	5	11		227	552	2.04
6.0 = 6.9	70	11	16			5	5	116	326	1.45
7.0 = 7.9	49	11						64	209	.68
8.0 = 8.9	65	54	5					134	145	1.02
9.0 = 9.9	11							12	12	.50
TOTAL	530	308	103	32	5	16	5			1.25
CUM. TOTAL	1000	470	162	59	27	22	5			
COL. AVG.	5.17*	5.32	5.34	5.33	5.50	5.83	6.50	5.27		

AVERAGE SIG. HEIGHT = 1.26 FT
 VARIANCE OF SIG. HEIGHT = 1.03 FT SQ
 STANDARD DEVIATION OF HEIGHT = 1.02 FT

AVERAGE WAVE PERIOD = 5.23 SEC*
 VARIANCE OF WAVE PERIOD = 3.78 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.95 SEC*

53 OBSERVATIONS

SUMMARY FOR NOV 71

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9	36							1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9	24	12						38	1000 1.83
3.0 = 3.9	24	60	12					100	963 1.38
4.0 = 4.9	12	48	36					100	863 1.75
5.0 = 5.9	84	157	60					313	763 1.42
6.0 = 6.9	36	84			12			138	450 1.50
7.0 = 7.9	12	24	24	24	24	12		125	313 3.00
8.0 = 8.9	24	72	36	12	12			163	188 1.96
9.0 = 9.9		12	12					25	25 2.00
TOTAL	253	470	181	36	48	12			1.69
CUM. TOTAL	1000	747	277	96	60	12			
COL. AVG.	5.50*	5.91	6.30	7.83	7.50	7.50	6.06		

AVERAGE SIG. HEIGHT = 1.68 FT

AVERAGE WAVE PERIOD = 6.03 SEC

VARIANCE OF SIG. HEIGHT = 1.03 FT SQ

VARIANCE OF WAVE PERIOD = 2.98 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.01 FT

STANDARD DEVIATION OF PERIOD = 1.73 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT CRYSTAL PIER.

* CALMS ARE OMITTED.

104 OBSERVATIONS

SUMMARY FOR DEC 71

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	ROW. AVG.*
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9								1000	0.00
3.0 = 3.9	10	58						67	1000 1.36
4.0 = 4.9		67	10					77	933 1.63
5.0 = 5.9	48	115	38	38	10			250	856 1.88
6.0 = 6.9	38	106	58	77	38			317	606 2.41
7.0 = 7.9	29	38	38	67	29	10		212	288 2.77
8.0 = 8.9	38				38			77	77 2.50
TOTAL	163	385	144	183	115	10			2.23
CUM. TOTAL	1000	837	452	308	125	10			
COL. AVG.	6.68*	5.50	6.37	6.66	7.33	7.50	6.26		

AVERAGE SIG. HEIGHT = 2.17 FT

AVERAGE WAVE PERIOD = 6.23 SEC

VARIANCE OF SIG. HEIGHT = 1.55 FT SQ

VARIANCE OF WAVE PERIOD = 1.53 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.25 FT

STANDARD DEVIATION OF PERIOD = 1.24 SEC

1865 OBSERVATIONS

SUMMARY FOR 21 MONTHS SEP 71 THROUGH JUL 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. ROW TOT.* AVG.*
0.0 = 1.0	12							8	1000 0.00
1.0 = 1.9	7	1						8	1000 .57
2.0 = 2.9	28	19	1					49	992 .94
3.0 = 3.9	36	66	12	1				116	943 1.30
4.0 = 4.9	19	64	34	4				123	827 1.69
5.0 = 5.9	47	107	76	38	10	2		283	705 2.01
6.0 = 6.9	36	61	49	31	11	2	1	194	422 2.13
7.0 = 7.9	20	24	17	19	8	2	1	91	228 2.27
8.0 = 8.9	36	30	17	14	11	2	1	112	137 1.97
9.0 = 9.9	9	6	4	1	2	2	1	22	25 2.30
10.0 = 10.9	1	1		1	1	1		3	3 3.10
11.0 = 11.9									1 0.00
12.0 = 12.9					1			1	1 4.50
TOTAL	248	379	210	109	43	10	2		1.86
CUM. TOTAL	1000	752	374	164	55	12	2		
COL. AVG.	5.52*	5.42	5.92	6.58	7.19	7.76	8.00	5.78	

AVERAGE SIG. HEIGHT = 1.05 FT

VARIANCE OF SIG. HEIGHT = 1.23 FT SQ

STANDARD DEVIATION OF HEIGHT = 1.11 FT

AVERAGE WAVE PERIOD = 5.79 SEC*

VARIANCE OF WAVE PERIOD = 3.07 SEC SQ*

STANDARD DEVIATION OF PERIOD = 1.75 SECS*

RESULTS OBTAINED FROM 1024*SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT CRYSTAL PIER.

* CALMS ARE OMITTED.

Table A-46. CERC wave gage history for Pleasure Pier, Galveston, Texas.

CERC Form 174-74 18 Mar 74		LOCATION: Pleasure Pier, Galveston, Texas							
COORDINATES: 29°17' N, 94°47' W.		Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Type of Gage Step-resistance staff-relay type	24 Mar. 1965	29 Apr. 1965	Electricity off.	25	-8 to +17	17	0 (gage facing southeast)	1,100	
	23 July 1965	5 Apr. 1967							
	9 June 1967	2 Nov. 1971							
	25 July 1972		Still operating.						

Table A-47. Number of analyzed pen and ink records from Galveston, Texas.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1965			25	99			44	166	170	150	150	75	879
1966	167	168	175	140	186	161	133	153	152	175	132	130	1872
1967	137	126	150	21		128	101						663

¹From 7-minute records taken six times daily and analyzed by the CERC method.

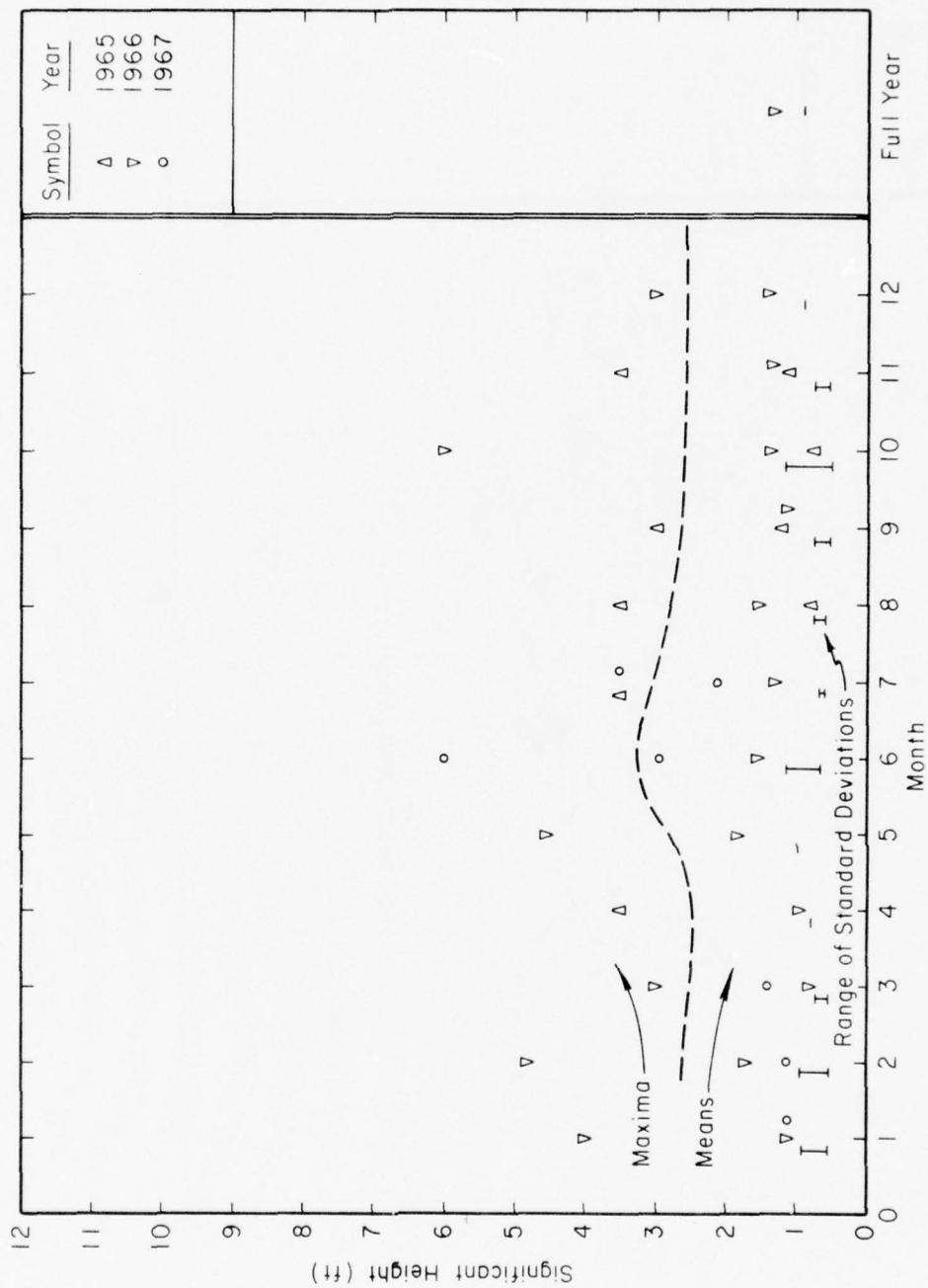


Figure A-74. Maxima, means, and standard deviations of significant height from Galveston, Texas; determined from 7-minute pen and ink records taken six times daily.

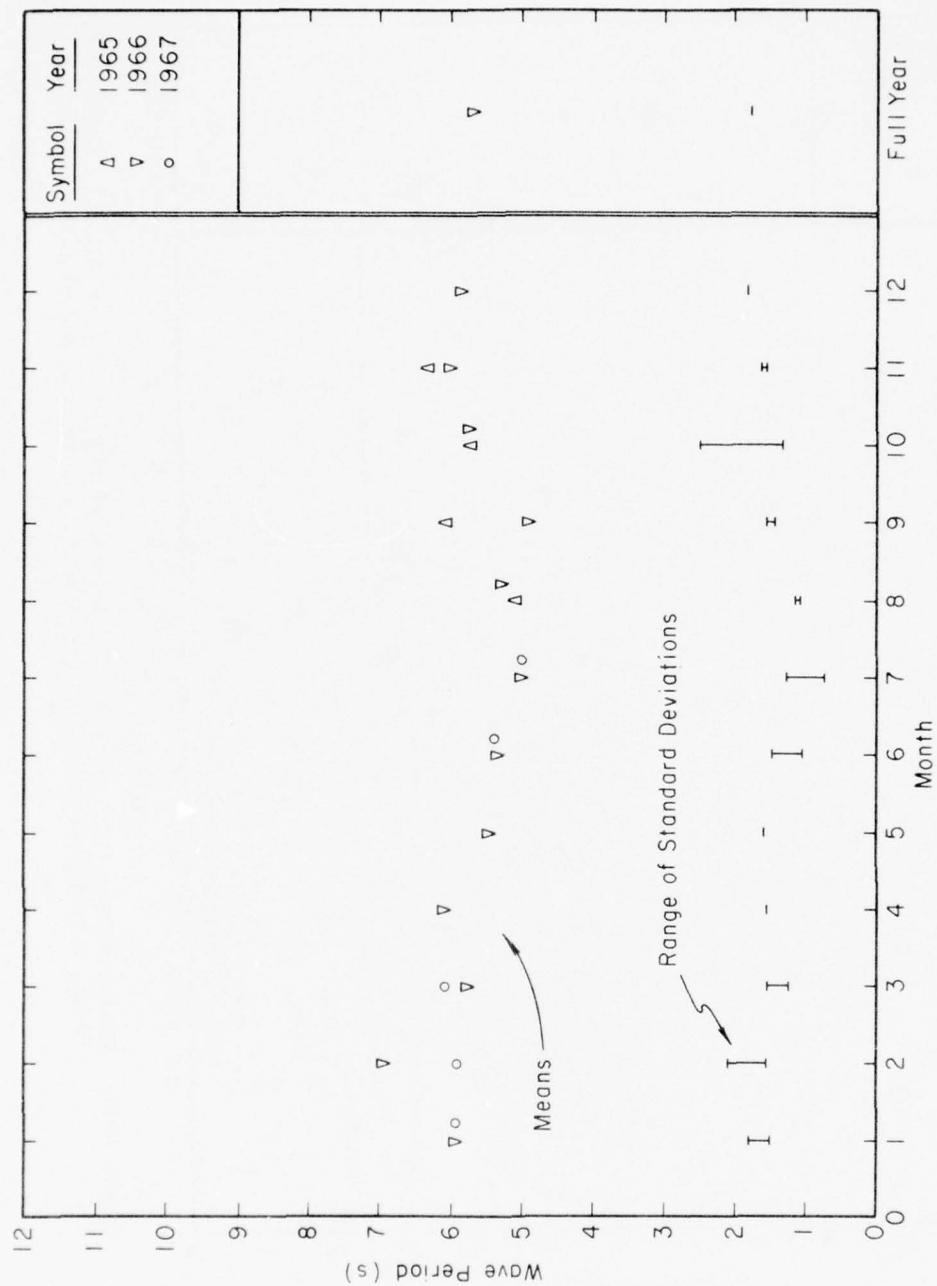


Figure A-75. Means and standard deviations of wave periods for Galveston, Texas; determined from 7-minute pen and ink records taken six times daily.

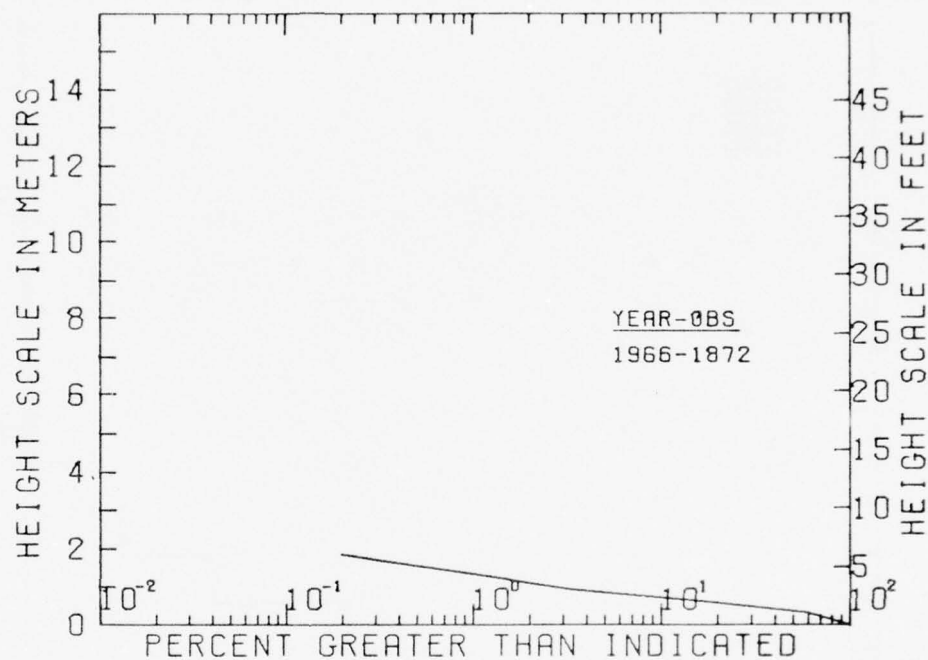


Figure A-76. Annual cumulative significant height distributions from Galveston, Texas; determined from 7-minute pen and ink records taken six times daily.

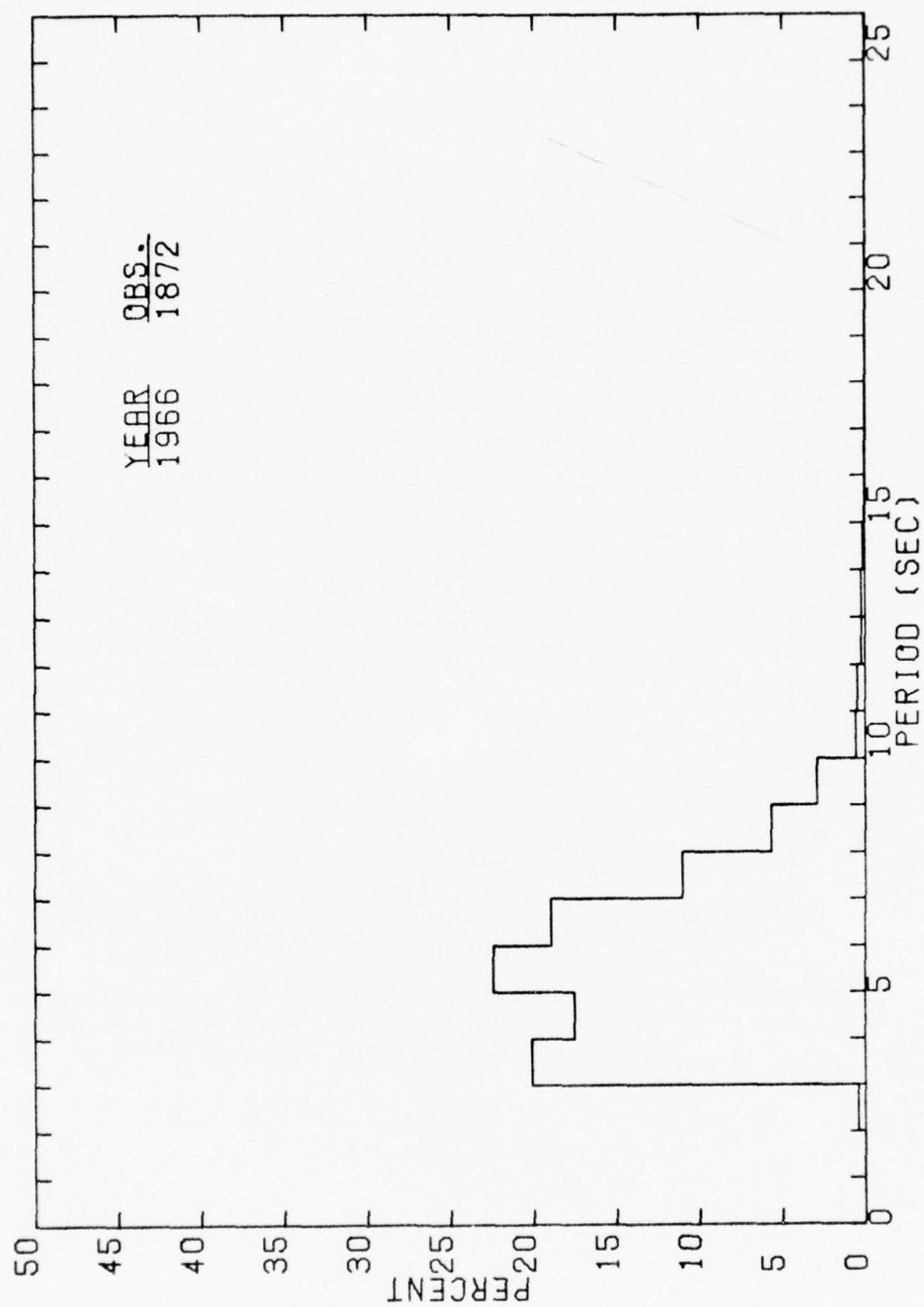


Figure A-77. Annual significant period distributions from Galveston, Texas; determined from 7-minute pen and ink records taken six times daily.

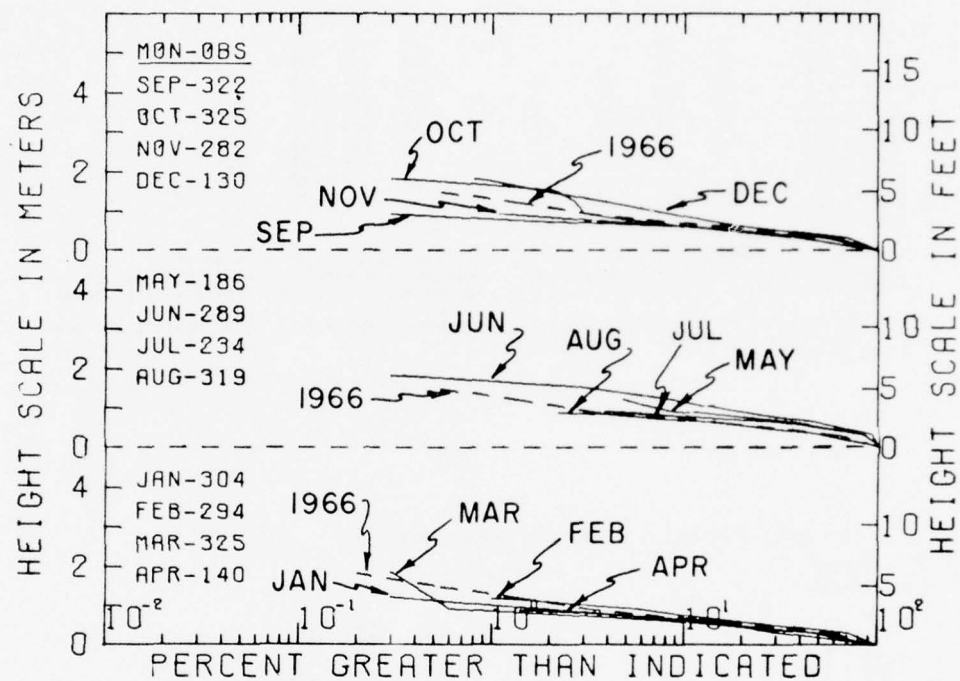


Figure A-78. Seasonal summaries of cumulative significant height distributions from Galveston, Texas; determined from 7-minute pen and ink records taken six times daily.

Table A-48. Wave climate for Galveston, Texas.
Distribution of significant height versus period
(in observations per 1,000 observations).

304 OBSERVATIONS										SUMMARY FOR JAN 66 JAN 67									
PERIOD (SECS)										HEIGHT (FT)									
										CUM. ROW									
										TOT. # TOT. # AVG. #									
.0 = 1.9										0=1	1=2	2=3	3=4	4=5	TOT. #	TOT. #	AVG. #		
2.0 = 2.4										178						1000	.00		
2.5 = 2.9										3	3				8	1000	1.00		
3.0 = 3.4																992	.00		
3.5 = 3.9										46	23				84	992	.83		
4.0 = 4.9										46	10				68	908	.68		
5.0 = 5.9										66	26	7			120	840	.90		
6.0 = 6.9										69	109	23			244	720	1.27		
7.0 = 7.9										59	86	20	3		204	476	1.30		
8.0 = 8.9										30	72	20	3		152	272	1.47		
9.0 = 9.9										30	26	13	7		92	120	1.46		
10.0 = 10.9										3	10		3	3	24	28	2.17		
TOTAL												3			4	4	2.50		
CUM. TOTAL										530	365	86	16	3			1.10		
COL. AVG.										1000	470	105	20	3					
										5.39	6.16	6.77	8.10	9.50	5.95				
AVERAGE SIG. HEIGHT = 1.10 FT										AVERAGE WAVE PERIOD = 5.95 SEC									
VARIANCE OF SIG. HEIGHT = .55 FT SQ										VARIANCE OF WAVE PERIOD = 2.76 SEC SQ									
STANDARD DEVIATION OF HEIGHT = .74 FT										STANDARD DEVIATION OF PERIOD = 1.66 SEC									
RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY																			
WAVE GAGE LOCATED AT PLEASURE PIER																			
• CALMS ARE OMITTED.																			

294 OBSERVATIONS										SUMMARY FOR FEB 66 FEB 67									
PERIOD (SECS)										HEIGHT (FT)									
		0=1	1=2	2=3	3=4	4=5	TOT, #	CUM, #	ROW										
1.0 = 1.9		27						1000	.00										
2.0 = 2.4		7					7	1000	.50										
2.5 = 2.9								993	.00										
3.0 = 3.4		44	20				66	993	.82										
3.5 = 3.9		34	34				70	927	1.00										
4.0 = 4.9		37	65				105	857	1.13										
5.0 = 5.9		27	99	7	3		140	752	1.40										
6.0 = 6.9		34	112	37	3		192	612	1.55										
7.0 = 7.9		34	109	27	3		178	420	1.50										
8.0 = 8.9		37	75	14	17	3	150	241	1.64										
9.0 = 9.9			27	17	10	7	63	91	2.44										
10.0 = 10.9			3	7	10		21	28	2.83										
11.0 = 11.9				7			7	7	2.50										
TOTAL		282	544	116	48	10			1.46										
CUM. TOTAL		1000	718	173	58	10													
COL. AVG.		5.48	6.44	7.88	8.71	9.17	6.50												
AVERAGE SIG. HEIGHT = 1.46 FT										AVERAGE WAVE PERIOD = 6.50 SEC									
VARIANCE OF SIG. HEIGHT = .68 FT SQ										VARIANCE OF WAVE PERIOD = 3.77 SEC SQ									
STANDARD DEVIATION OF HEIGHT = .82 FT										STANDARD DEVIATION OF PERIOD = 1.94 SEC									

324 OBSERVATIONS

SUMMARY FOR MAR 66 MAR 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 - 1.9	150					1000	.00
2.0 - 2.9						1000	.00
2.5 - 2.9						1000	.00
3.0 - 3.9	43	3			55	1000	.57
3.5 - 3.9	31	12			51	945	.79
4.0 - 4.9	49	62	3		136	893	1.09
5.0 - 5.9	102	130	12		290	757	1.13
6.0 - 6.9	46	114	34	3	235	467	1.47
7.0 - 7.9	40	68	25		158	232	1.36
8.0 - 8.9	40	9	3		62	74	.79
9.0 - 9.9	6	3			11	11	.63
TOTAL	519	401	77	3			1.06
CUM. TOTAL	1000	401	80	3			
COL. AVG.	5.70*	6.00	6.06	6.50	5.93		

AVERAGE SIG. HEIGHT = 1.06 FT
 VARIANCE OF SIG. HEIGHT = .42 FT SQ
 STANDARD DEVIATION OF HEIGHT = .65 FT

AVERAGE WAVE PERIOD = 5.93 SEC*
 VARIANCE OF WAVE PERIOD = 1.99 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.41 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND TAP RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 * WAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

140 OBSERVATIONS

SUMMARY FOR APR 66

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 - 1.9	200					1000	.00
2.0 - 2.9						1000	.00
2.5 - 2.9						1000	.00
3.0 - 3.9	29				36	1000	.50
3.5 - 3.9	57				71	964	.50
4.0 - 4.9	114		14		161	893	.72
5.0 - 5.9	121	14	21		196	732	.86
6.0 - 6.9	136	16	50		277	536	1.11
7.0 - 7.9	29	50	43	14	170	259	1.62
8.0 - 8.9		21			27	89	1.50
9.0 - 9.9	14	36			62	62	1.21
TOTAL	700	157	129	14			.96
CUM. TOTAL	1000	300	143	14			
COL. AVG.	5.44*	7.68	6.44	7.50	6.08		

AVERAGE SIG. HEIGHT = .96 FT
 VARIANCE OF SIG. HEIGHT = .59 FT SQ
 STANDARD DEVIATION OF HEIGHT = .77 FT

AVERAGE WAVE PERIOD = 6.08 SEC*
 VARIANCE OF WAVE PERIOD = 2.42 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.56 SEC*

186 OBSERVATIONS

SUMMARY FOR MAY 66

PERIOD (SECS)	HEIGHT (FT)						CUM.	ROW
	0=1	1=2	2=3	3=4	4=5	TOT.	TOT.	AVG.
1.0 = 1.9	16						1000	.00
2.0 = 2.4	5					5	1000	.50
2.5 = 2.9							995	.00
3.0 = 3.4	65	43				109	995	.90
3.5 = 3.9	59	65				126	885	1.02
4.0 = 4.9	11	81	54			148	760	1.80
5.0 = 5.9	11	129	113	11		268	612	1.97
6.0 = 6.9	9	108	86	16		219	344	2.02
7.0 = 7.9	22	22		5	11	60	126	1.86
8.0 = 8.9		5		5	22	33	66	3.83
9.0 = 9.9			16		11	27	33	3.30
10.0 = 10.9							5	.00
11.0 = 11.9					5	5	5	4.50
TOTAL	194	452	269	38	48			1.80
CUM. TOTAL	1000	806	355	86	48			
COL. AVG.	4.21*	5.23	5.86	6.64	6.83	5.45		

AVERAGE SIG. HEIGHT = 1.80 FT AVERAGE WAVE PERIOD = 5.45 SEC*
 VARIANCE OF SIG. HEIGHT = .96 FT SQ VARIANCE OF WAVE PERIOD = 2.53 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .98 FT STANDARD DEVIATION OF PERIOD = 1.59 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

269 OBSERVATIONS

SUMMARY FOR JUN 66 JUN 67

PERIOD (SECS)	HEIGHT (FT)							CUM.	ROW
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.	AVG.
1.0 = 1.9	3							1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4	14	31			5			49	1.43
3.5 = 3.9	14	76	24					115	951
4.0 = 4.9	24	111	90	24	3			253	837
5.0 = 5.9	17	80	111	31	24	7		271	583
6.0 = 6.9	10	90	48	17	24	14	3	208	312
7.0 = 7.9	3	45	28	10	3	3		94	104
8.0 = 8.9								10	.00
9.0 = 9.9		7						7	10
10.0 = 10.9								3	.00
11.0 = 11.9		3						3	1.50
TOTAL	87	443	301	83	59	24	3		2.17
CUM. TOTAL	1000	913	471	170	87	28	3		
COL. AVG.	4.75*	5.31	5.41	5.67	5.84	6.36	6.50	5.38	

AVERAGE SIG. HEIGHT = 2.17 FT AVERAGE WAVE PERIOD = 5.38 SEC*
 VARIANCE OF SIG. HEIGHT = 1.27 FT SQ VARIANCE OF WAVE PERIOD = 1.86 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.13 FT STANDARD DEVIATION OF PERIOD = 1.29 SEC*

234 OBSERVATIONS

SUMMARY FOR JUL 66 JUL 67

PERIOD (SECS)	HEIGHT (FT)					CUM.	ROW
	0=1	1=2	2=3	3=4	TOT.*	TOT.*	AVG.*
1.0 = 1.9	9					1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4	21	85			108	1000	1.30
3.5 = 3.9	13	47	17		78	892	1.56
4.0 = 4.9	43	158	103	4	310	815	1.72
5.0 = 5.9	43	175	120	2.	362	504	1.83
6.0 = 6.9	9	47	38	4	99	142	1.69
7.0 = 7.9	21	9			30	43	.79
8.0 = 8.9	13				13	13	.50
TOTAL	171	521	278	30			1.67
CUM. TOTAL	1000	829	308	30			
COL. AVG.	5.36*	4.79	5.16	5.50	5.01		

AVERAGE SIG. HEIGHT = 1.67 FT AVERAGE WAVE PERIOD = 5.01 SEC*
 VARIANCE OF SIG. HEIGHT = .54 FT SQ VARIANCE OF WAVE PERIOD = 1.19 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .74 FT STANDARD DEVIATION OF PERIOD = 1.09 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

338 OBSERVATIONS

SUMMARY FOR AUG 65 AUG 66

PERIOD (SECS)	HEIGHT (FT)					CUM.	ROW
	0=1	1=2	2=3	3=4	TOT.*	TOT.*	AVG.*
1.0 = 1.9	38					1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4	44	25			72	1000	.86
3.5 = 3.9	78	47			130	928	.88
4.0 = 4.9	132	72	6		218	798	.90
5.0 = 5.9	166	122	28	3	332	580	1.09
6.0 = 6.9	66	69	56	9	208	248	1.55
7.0 = 7.9	6	3	19	9	39	39	2.33
TOTAL	530	339	110	22			1.12
CUM. TOTAL	1000	470	132	22			
COL. AVG.	4.91*	5.10	6.30	6.79	5.18		

AVERAGE SIG. HEIGHT = 1.12 FT AVERAGE WAVE PERIOD = 5.18 SEC*
 VARIANCE OF SIG. HEIGHT = .59 FT SQ VARIANCE OF WAVE PERIOD = 1.24 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .77 FT STANDARD DEVIATION OF PERIOD = 1.11 SEC*

322 OBSERVATIONS

SUMMARY FOR SEP 65 SEP 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.9	56					1000	.00
2.0 = 2.4	3				3	1000	.50
2.5 = 2.9						997	.00
3.0 = 3.4	93	28			128	997	.73
3.5 = 3.9	25	50			79	868	1.17
4.0 = 4.9	81	90			181	789	1.03
5.0 = 5.9	87	121	19		240	609	1.20
6.0 = 6.9	50	68	47		174	368	1.48
7.0 = 7.9	28	87	22	3	148	194	1.50
8.0 = 8.9	16	19			36	46	1.05
9.0 = 9.9						10	.00
10.0 = 10.9	3				3	10	.50
11.0 = 11.9		3			3	7	1.50
12.0 = 12.9						3	.00
13.0 = 13.9						3	.00
14.0 = 14.9		3			3	3	1.50
TOTAL	441	469	87	3			1.15
CUM. TOTAL	1000	559	90	3			
COL. AVG.	5.04*	5.72	6.34	7.50	5.53		

AVERAGE SIG. HEIGHT = 1.15 FT

VARIANCE OF SIG. HEIGHT = .42 FT SQ

STANDARD DEVIATION OF HEIGHT = .65 FT

AVERAGE WAVE PERIOD = 5.53 SEC*

VARIANCE OF WAVE PERIOD = 2.67 SEC SQ*

STANDARD DEVIATION OF PERIOD = 1.63 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 HAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

325 OBSERVATIONS

SUMMARY FOR OCT 65 OCT 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW. AVG.*
1.0 = 1.9	222								1000	.00
2.0 = 2.4									1000	.00
2.5 = 2.9									1000	.00
3.0 = 3.4	62	3						83	1000	.55
3.5 = 3.9	46	18						83	917	.79
4.0 = 4.9	95	86						233	834	.97
5.0 = 5.9	86	114	12					273	601	1.15
6.0 = 6.9	98	43	31					170	328	1.29
7.0 = 7.9	22	22	3					59	158	1.10
8.0 = 8.9	12	6	6					32	99	1.25
9.0 = 9.9	6		3					12	67	1.17
10.0 = 10.9		3			3			8	55	3.00
11.0 = 11.9			6			3		12	47	3.50
12.0 = 12.9			3			6	3	16	36	5.00
13.0 = 13.9					3	6		12	20	5.17
14.0 = 14.9				3		3		8	8	4.80
TOTAL	609	295	65	3	6	18	3			1.07
CUM. TOTAL	1000	391	95	31	28	22	3			
COL. AVG.	5.11*	5.48	7.49	14.50	12.00	13.00	12.50	5.75		

AVERAGE SIG. HEIGHT = 1.07 FT

VARIANCE OF SIG. HEIGHT = .93 FT SQ

STANDARD DEVIATION OF HEIGHT = .96 FT

AVERAGE WAVE PERIOD = 5.75 SEC*

VARIANCE OF WAVE PERIOD = 4.52 SEC SQ*

STANDARD DEVIATION OF PERIOD = 2.13 SEC*

282 OBSERVATIONS

SUMMARY FOR NOV 65 NOV 66

PERIOD (SECS)	HEIGHT (FT)				CUM. ROW		
	0-1	1-2	2-3	3-4	TOT.*	TOT.*	AVG.*
1.0 = 1.9	43					1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4	39	4			44	1000	.58
3.5 = 3.9	32	14			48	956	.81
4.0 = 4.9	71	64			141	907	.97
5.0 = 5.9	135	117	25		289	767	1.10
6.0 = 6.9	21	131	21	4	185	478	1.34
7.0 = 7.9	43	89	21		159	293	1.36
8.0 = 8.9	14	43	7	7	74	133	1.60
9.0 = 9.9	11	32	7		52	59	1.43
10.0 = 10.9		4	4		7	7	2.00
TOTAL	408	496	85	11			1.20
CUM. TOTAL	1000	592	96	11			
COL. AVG.	5.44*	6.48	7.04	7.83	6.15		

AVERAGE SIG. HEIGHT = 1.20 FT AVERAGE WAVE PERIOD = 6.15 SEC*
 VARIANCE OF SIG. HEIGHT = .44 FT SQ VARIANCE OF WAVE PERIOD = 2.60 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .67 FT STANDARD DEVIATION OF PERIOD = 1.61 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

129 OBSERVATIONS

SUMMARY FOR DEC 66

PERIOD (SECS)	HEIGHT (FT)					
	0-1	1-2	2-3	TOT.*	CUM. TOT.*	ROW AVG.*
1.0 = 1.9	62				1000	.00
2.0 = 2.4					1000	.00
2.5 = 2.9					1000	.00
3.0 = 3.4	101	54		165	1000	.85
3.5 = 3.9	8	62		74	835	1.39
4.0 = 4.9	16	101	8	132	760	1.44
5.0 = 5.9	8	78	16	107	628	1.58
6.0 = 6.9	39	132	31	215	521	1.46
7.0 = 7.9	31	39	85	165	306	1.85
8.0 = 8.9	39	23	39	107	140	1.50
9.0 = 9.9	8	23		33	33	1.25
TOTAL	310	512	178			1.37
CUM. TOTAL	1000	690	178			
COL. AVG.	5.47*	5.58	7.24	5.87		

AVERAGE SIG. HEIGHT = 1.37 FT AVERAGE WAVE PERIOD = 5.87 SEC*
 VARIANCE OF SIG. HEIGHT = .67 FT SQ VARIANCE OF WAVE PERIOD = 3.43 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .82 FT STANDARD DEVIATION OF PERIOD = 1.85 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY
 WAVE GAGE LOCATED AT PLEASURE PIER
 * CALMS ARE OMITTED.

314# OBSERVATIONS

SUMMARY FOR 21 MONTHS AUG 65 THROUGH JUL 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	80								1000	.00
2.0 - 2.9	2							2	1000	.67
3.0 - 3.9	49	24						81	998	.00
4.0 - 4.9	37	35	3					53	917	1.05
5.0 - 5.9	64	77	22	3				181	834	1.28
6.0 - 6.9	78	112	40	6	2	1		250	653	1.43
7.0 - 7.9	43	86	40	5	2	1		195	393	1.62
8.0 - 8.9	25	53	21	4	1			115	198	1.57
9.0 - 9.9	17	19	6	3	2			51	83	1.49
10.0 - 10.9	3	10	3	1	2			22	32	1.87
11.0 - 11.9		1	1	1				4	10	2.50
12.0 - 12.9		1	1					3	6	2.67
13.0 - 13.9						1		1	3	5.00
14.0 - 14.9						1		1	2	5.17
TOTAL	405	419	139	23	10	4	1	1	1	3.50
CUM. TOTAL	1000	595	176	38	15	5	1			1.33
COL. AVG.	5.24*	5.75	6.24	6.92	7.49	8.42	9.50	5.71		

AVERAGE SIG. HEIGHT = 1.33 FT

VARIANCE OF SIG. HEIGHT = .176 FT SQ

STANDARD DEVIATION OF HEIGHT = .87 FT

AVERAGE WAVE PERIOD = 5.71 SEC*

VARIANCE OF WAVE PERIOD = 2.70 SEC SQ*

STANDARD DEVIATION OF PERIOD = 1.64 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE RELAY

WAVE GAGE LOCATED AT PLEASURE PIER

* CALCS ARE OMITTED.

APPENDIX A-3

SIGNIFICANT WAVE HEIGHT AND PERIOD SUMMARIES, U.S. PACIFIC COAST



Figure A-79. Location of BEB-CERC wave gages along the U.S. Pacific coast.

Table A 49. CERC wave gage history for Phillips Petroleum Company Oil Platform *Harry*, Pt. Conception, California.

CERC Form 174-74

18 Mar 74

COORDINATES: 34°25' N., 120°24' W.

LOCATION: Phillips Petroleum Company Oil Platform *Harry*,
Pt. Conception, California

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step resistance staff	28 Apr. 1966	21 Jan. 1967		30	-12 to +18	100	Platform is 1.5 miles offshore (gage is on southwest corner)	
	22 Mar. 1967	13 Mar. 1968						
	21 May 1968	12 Aug. 1968						
	18 Sept. 1968	20 Oct. 1968	Records no longer sent to CERC.					

Table A-50. Number of analyzed pen and ink records from
Pt. Conception, California.¹

YR \ MO	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1966					83	139	151	169	116	138	162	160	1118

¹From 7-minute records taken six times daily and analyzed by the CERC method.

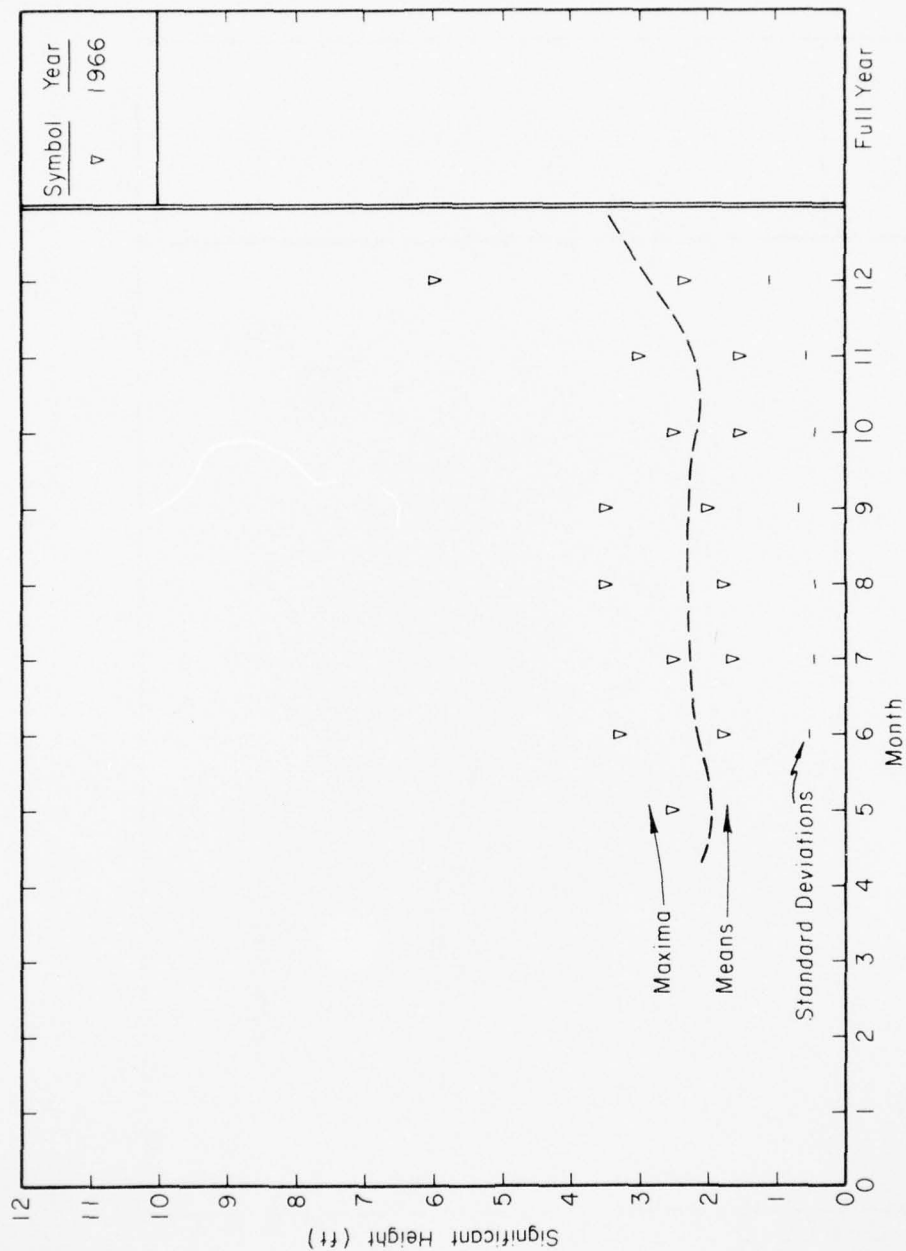


Figure A-80. Maxima, means, and standard deviation of significant height from Pt. Conception, California. Determined from 7-minute pen and ink records taken six times daily. Wave heights may be low due to old gage design and maintenance difficulties.

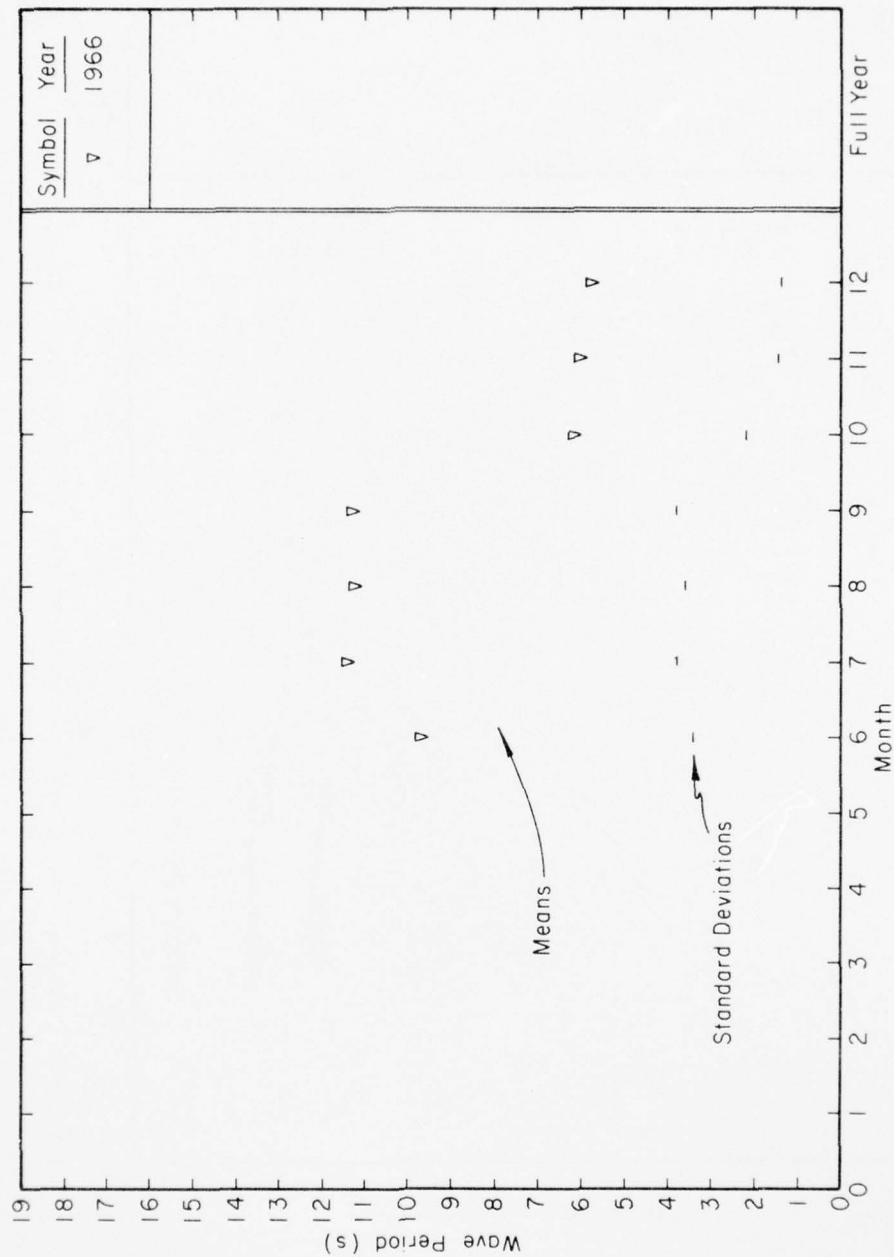


Figure A-81. Means and standard deviations of wave period from Pt. Conception, California; determined from 7-minute pen and ink records taken six times daily.

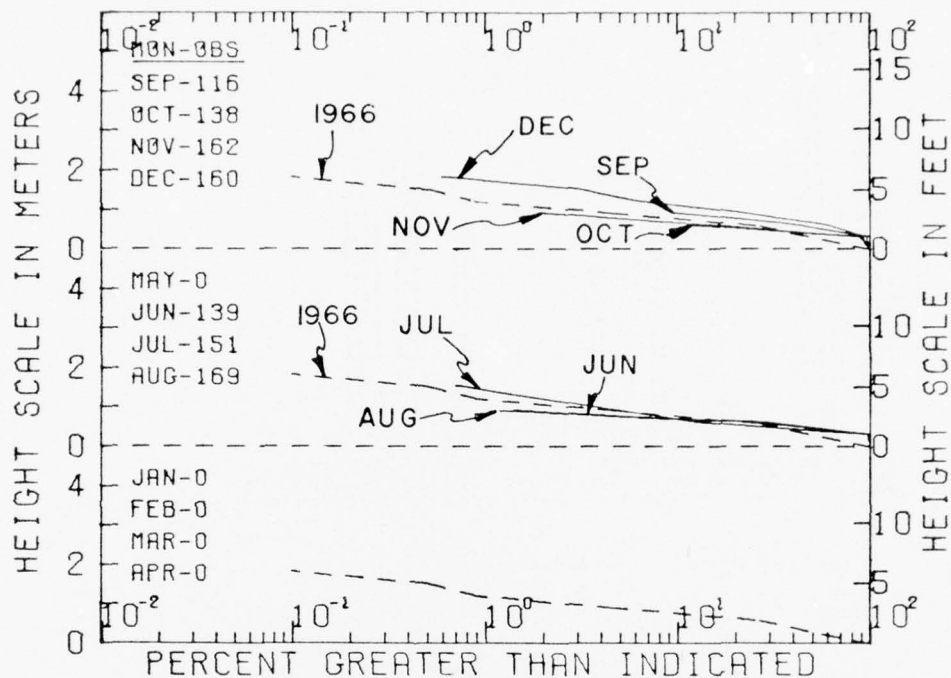


Figure A-82. Seasonal summaries of cumulative height distributions from Pt. Conception, California. Determined from 7-minute pen and ink records taken six times daily. Wave heights may be low due to old gage design and maintenance difficulties.

Table A-51. Wave climate for Pt. Conception, California.
Distribution of significant height versus period
(in observations per 1,000 observations).

139 OBSERVATIONS		SUMMARY FOR JUN 66					
PERIOD (SECS)		HEIGHT (FT)				CUM. TOT.*	ROW TOT.* AVG.*
		0-1	1-2	2-3	3-4	TOT.*	
1.0 - 1.9							1000 .00
2.0 - 2.9							1000 .00
3.0 - 3.9							1000 .00
4.0 - 4.9							1000 .00
5.0 - 5.9			29	14		43	1000 1.83
6.0 - 6.9		7	79	7		94	957 1.50
7.0 - 7.9			72	22		94	863 1.73
8.0 - 8.9			108	43	7	158	770 1.86
9.0 - 9.9			94	36	7	137	612 1.87
10.0 - 10.9			65	29		94	475 1.81
11.0 - 11.9		7	43	7		58	381 1.50
12.0 - 12.9			14			14	324 1.50
13.0 - 13.9				29		29	309 2.50
14.0 - 14.9			29	14		43	281 1.83
15.0 - 15.9		22	137	65		223	237 1.69
16.0 - 16.9							14 .00
TOTAL		36	676	273	14	14	14 2.00
CUM. TOTAL		1000	964	288	14		1.77
COL. AVG.		11.90*	9.40	10.37	8.00	9.74	

AVERAGE SIG. HEIGHT = 1.77 FT
 VARIANCE OF SIG. HEIGHT = .30 FT SQ
 STANDARD DEVIATION OF HEIGHT = .54 FT
 AVERAGE WAVE PERIOD = 9.74 SEC*
 VARIANCE OF WAVE PERIOD = 11.48 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 3.39 SEC*

150 OBSERVATIONS		SUMMARY FOR JUL 66					
PERIOD (SECS)		HEIGHT (FT)				CUM. TOT.*	ROW TOT.* AVG.*
		0-1	1-2	2-3	3-4	TOT.*	
1.0 - 1.9							1000 .00
2.0 - 2.9							1000 .00
3.0 - 3.9							1000 .00
4.0 - 4.9			7			7	1000 1.50
5.0 - 5.9							993 .00
6.0 - 6.9			40			40	993 1.50
7.0 - 7.9		7	47			53	953 1.37
8.0 - 8.9			73	13		87	900 1.65
9.0 - 9.9			93	7		100	813 1.57
10.0 - 10.9			60			60	713 1.50
11.0 - 11.9			20			20	653 1.50
12.0 - 12.9			7			7	633 1.50
13.0 - 13.9							627 1.50
14.0 - 14.9			107			107	607 1.50
15.0 - 15.9			320	60		380	540 1.50
16.0 - 16.9				7		7	433 1.66
TOTAL		7	13	33		47	53 2.50
CUM. TOTAL		1000	993	120			47 2.21
COL. AVG.		5.50*	11.19	13.43		11.46	1.61

AVERAGE SIG. HEIGHT = 1.61 FT
 VARIANCE OF SIG. HEIGHT = .11 FT SQ
 STANDARD DEVIATION OF HEIGHT = .34 FT
 AVERAGE WAVE PERIOD = 11.46 SEC*
 VARIANCE OF WAVE PERIOD = 13.91 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 3.73 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT PHILLIPS PLATFORM HARRY,
 * GALS ARE OMITTED.
 Wave heights may be low due to old gage design and maintenance difficulties.

169 OBSERVATIONS

SUMMARY FOR AUG 66

PERIOD (SECS)	HEIGHT (FT)				CUM. TOT.*	ROW TOT.*	AVG.*
	0=1	1=2	2=3	3=4			
.0 = 1.9					1000	1000	.00
2.0 = 2.4					1000	1000	.00
2.5 = 2.9					1000	1000	.00
3.0 = 3.4					1000	1000	.00
3.5 = 3.9		6			6	1000	1.50
4.0 = 4.9		47	6		53	994	1.61
5.0 = 5.9		47			47	941	1.50
6.0 = 6.9		47	6		53	893	1.61
7.0 = 7.9		59	6		65	840	1.59
8.0 = 8.9		47			47	775	1.50
9.0 = 9.9		107			107	728	1.50
10.0 = 10.9		59	18		77	621	1.73
11.0 = 11.9		41	12		53	544	1.72
12.0 = 12.9		36	18		53	491	1.83
13.0 = 13.9		47	36		83	438	1.93
14.0 = 14.9		201	95		296	355	1.82
15.0 = 15.9						59	.00
16.0 = 16.9		12	36	12	59	59	2.50
TOTAL		757	241	12			1.75
CUM. TOTAL	1000	1000	243	12			
COL. AVG.	.00	10.50	13.40	16.50	11.24		

AVERAGE SIG. HEIGHT = 1.75 FT
 VARIANCE OF SIG. HEIGHT = .21 FT SQ
 STANDARD DEVIATION OF HEIGHT = .46 FT

AVERAGE WAVE PERIOD = 11.24 SEC*
 VARIANCE OF WAVE PERIOD = 12.43 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 3.53 SEC*

116 OBSERVATIONS

SUMMARY FOR SEP 66

PERIOD (SECS)	HEIGHT (FT)				CUM. TOT.*	ROW TOT.*	AVG.*
	0=1	1=2	2=3	3=4			
.0 = 1.9					1000	1000	.00
2.0 = 2.4					1000	1000	.00
2.5 = 2.9					1000	1000	.00
3.0 = 3.4					1000	1000	.00
3.5 = 3.9		26			26	1000	1.50
4.0 = 4.9		17			17	974	1.50
5.0 = 5.9		52			52	957	1.50
6.0 = 6.9		95	9		103	905	1.58
7.0 = 7.9		34	26		60	862	1.93
8.0 = 8.9		26	34		60	741	2.07
9.0 = 9.9		26	43		69	681	2.12
10.0 = 10.9		26	17		43	612	1.90
11.0 = 11.9		17	9		26	569	1.83
12.0 = 12.9			26		26	543	2.50
13.0 = 13.9		60	26	9	95	517	1.95
14.0 = 14.9		216	95	34	345	422	1.97
15.0 = 15.9			9	17	26	78	3.17
16.0 = 16.9			17	34	52	52	3.17
TOTAL		595	310	95			2.00
CUM. TOTAL	1000	1000	405	95			
COL. AVG.	.00	10.44	11.92	15.32	11.36		

AVERAGE SIG. HEIGHT = 2.00 FT
 VARIANCE OF SIG. HEIGHT = .44 FT SQ
 STANDARD DEVIATION OF HEIGHT = .66 FT

AVERAGE WAVE PERIOD = 11.36 SEC*
 VARIANCE OF WAVE PERIOD = 13.87 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 3.72 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT PHILLIPS PLATFORM HARRY.
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

138 OBSERVATIONS

SUMMARY FOR OCT 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	TOT.*	CUM.* TOT.*	RD=
1.0 = 1.9					1000	.00
2.0 = 2.4					1000	.00
2.5 = 2.9					1000	.00
3.0 = 3.4	7	94	29	130	1000	1.67
3.5 = 3.9		51	7	58	870	1.62
4.0 = 4.9		65	14	80	812	1.68
5.0 = 5.9	29	101	29	159	732	1.50
6.0 = 6.9	29	312	14	355	572	1.46
7.0 = 7.9	14	123	14	152	217	1.50
8.0 = 8.9		14		14	65	1.50
9.0 = 9.9		7		7	51	1.50
10.0 = 10.9					43	.00
11.0 = 11.9					43	.00
12.0 = 12.9		7		7	43	1.50
13.0 = 13.9		22		22	36	1.50
14.0 = 14.9		14		14	14	1.50
TOTAL	80	812	109			1.53
CUM. TOTAL	1000	920	109			
COL. AVG.	6.02*	6.26	5.05	6.11		

AVERAGE SIG. HEIGHT = 1.53 FT
 VARIANCE OF SIG. HEIGHT = .19 FT SQ
 STANDARD DEVIATION OF HEIGHT = .43 FT

AVERAGE WAVE PERIOD = 6.11 SEC*
 VARIANCE OF WAVE PERIOD = 4.67 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 2.16 SEC*

162 OBSERVATIONS

SUMMARY FOR NOV 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	TOT.*	CUM.* TOT.*	RD=
1.0 = 1.9						1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4		37	19		56	1000	1.83
3.5 = 3.9		49	19		68	944	1.77
4.0 = 4.9	6	68	12		86	877	1.57
5.0 = 5.9	12	173	43	19	247	790	1.77
6.0 = 6.9	43	247	12		302	543	1.40
7.0 = 7.9	56	117	19		191	241	1.31
8.0 = 8.9	6	43			49	49	1.37
TOTAL	123	735	123	19			1.54
CUM. TOTAL	1000	877	142	19			
COL. AVG.	6.85*	6.01	5.20	5.50	6.00		

AVERAGE SIG. HEIGHT = 1.54 FT
 VARIANCE OF SIG. HEIGHT = .32 FT SQ
 STANDARD DEVIATION OF HEIGHT = .57 FT

AVERAGE WAVE PERIOD = 6.00 SEC*
 VARIANCE OF WAVE PERIOD = 1.83 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 1.35 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 * WAVE GAGE LOCATED AT PHILLIPS PLATFORM HARRY.
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

160 OBSERVATIONS

SUMMARY FOR DEC 66

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM.* TOT.*	ROK. AVG.*
1.0 = 1.9	6								1000	.00
2.0 = 2.9									1000	.00
3.0 = 3.9									1000	.00
4.0 = 4.9			13	6	6			25	1000	3.25
5.0 = 5.9	6	31	25	31	6	6	6	113	975	2.89
6.0 = 6.9	6	44	50	19	6	19		145	862	2.72
7.0 = 7.9	6	125	56	31				220	717	2.01
8.0 = 8.9		138	169	31				340	497	2.19
9.0 = 9.9	19	19	56	19	6			119	157	2.29
TOTAL		6	6	6	6			25	38	3.00
CUM. TOTAL	44	363	375	156	31	25	6	13	13	3.50
COL. AVG.	1000	956	594	219	63	31	6			2.37
	6.04	5.76	5.97	5.82	5.50	4.31	3.75	5.81		

AVERAGE SIG. HEIGHT = 2.37 FT

AVERAGE WAVE PERIOD = 5.81 SEC*

VARIANCE OF SIG. HEIGHT = 1.13 FT SQ

VARIANCE OF WAVE PERIOD = 1.77 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.06 FT

STANDARD DEVIATION OF PERIOD = 1.33 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT PHILLIPS PLATFORM HARRY.

* CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

Table A-52. CERC wave gage history for Port Hueneme, California (Gage No. 715).

CERC Form 174-74 18 Mar 74		LOCATION: Port Hueneme, California (Gage No. 715)					
COORDINATES: 34°10' N., 119°14' W.							
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Pier Length (feet)
Step-resistance, staff-parallel type	9 Nov. 1961	25 Apr. 1962	Underwater cable from gage to recorder defective.	25	-10 to +15	23	Gage mounted on steel pile off north end of breakwater at Ventura County Harbor.
	29 June 1962	31 Jan. 1963	Cable broken.				
	16 Aug. 1963	30 June 1964	Gage taken over by Los Angeles District.				
	21 June 1965	9 Dec. 1965	Gage fouled.				
	11 Jan. 1967	25 Dec. 1967					
	13 Mar. 1968	17 Aug. 1968	Gage discontinued.				

Table 53. Number of analyzed pen and ink records from Port Hueneme, California.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1961											128	186	314
1962	185	167	186	150		8	175	185	180	186	180	124	1726
1963	171							92	161	186	180	186	976
1964	186	168	184	173	161	178							1050
1965						41	165	149	179	115	101	54	1430

¹From 7-minute records taken six times daily; analyzed by the second BEB method for 1961 to March 1964 and analyzed by the CERC method for April 1964 to 1965.

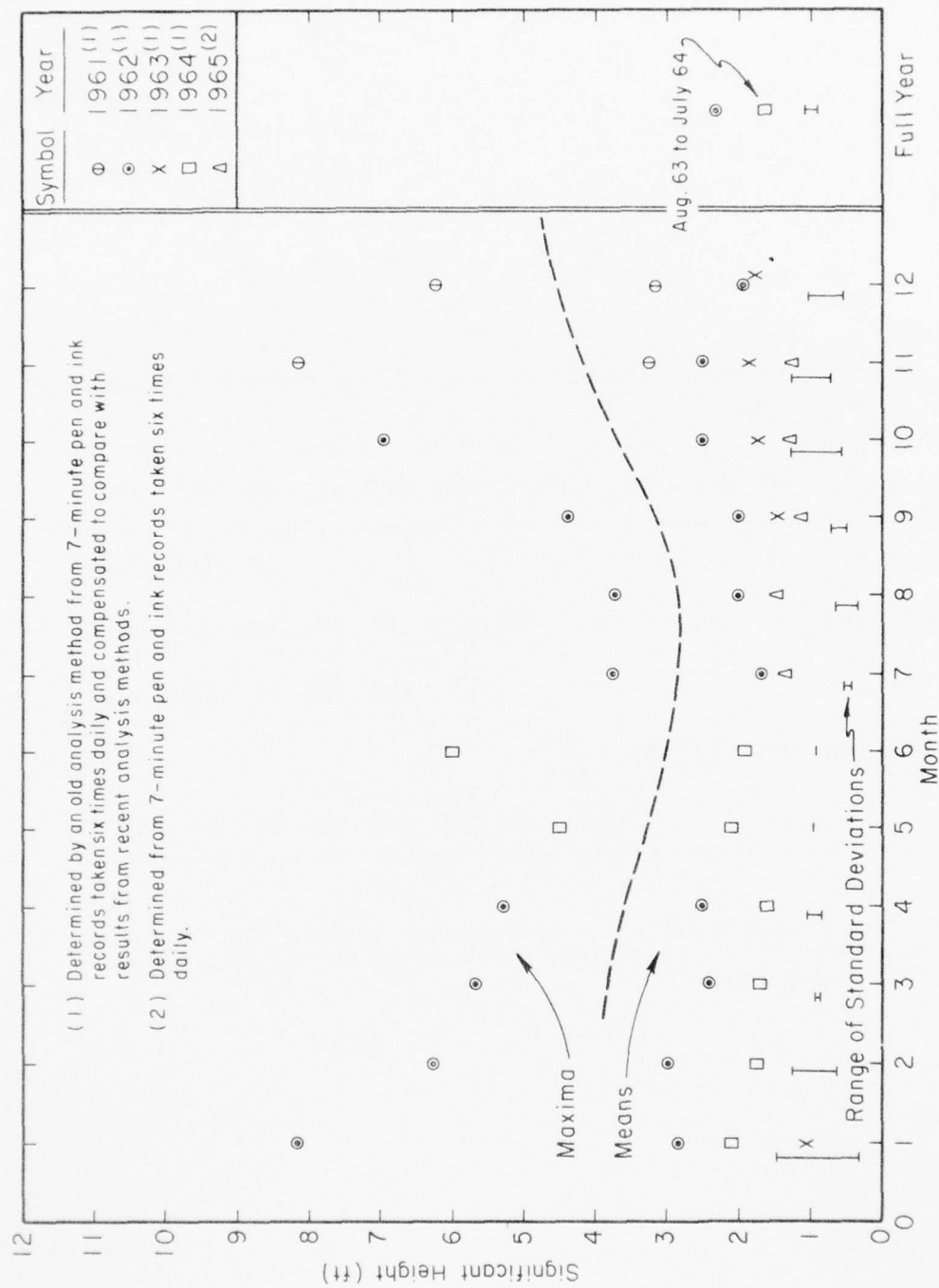


Figure A-83. Maxima, means, and standard deviation of significant height from Port Hueneme, California. Wave heights may be low due to old gage design and maintenance difficulties.

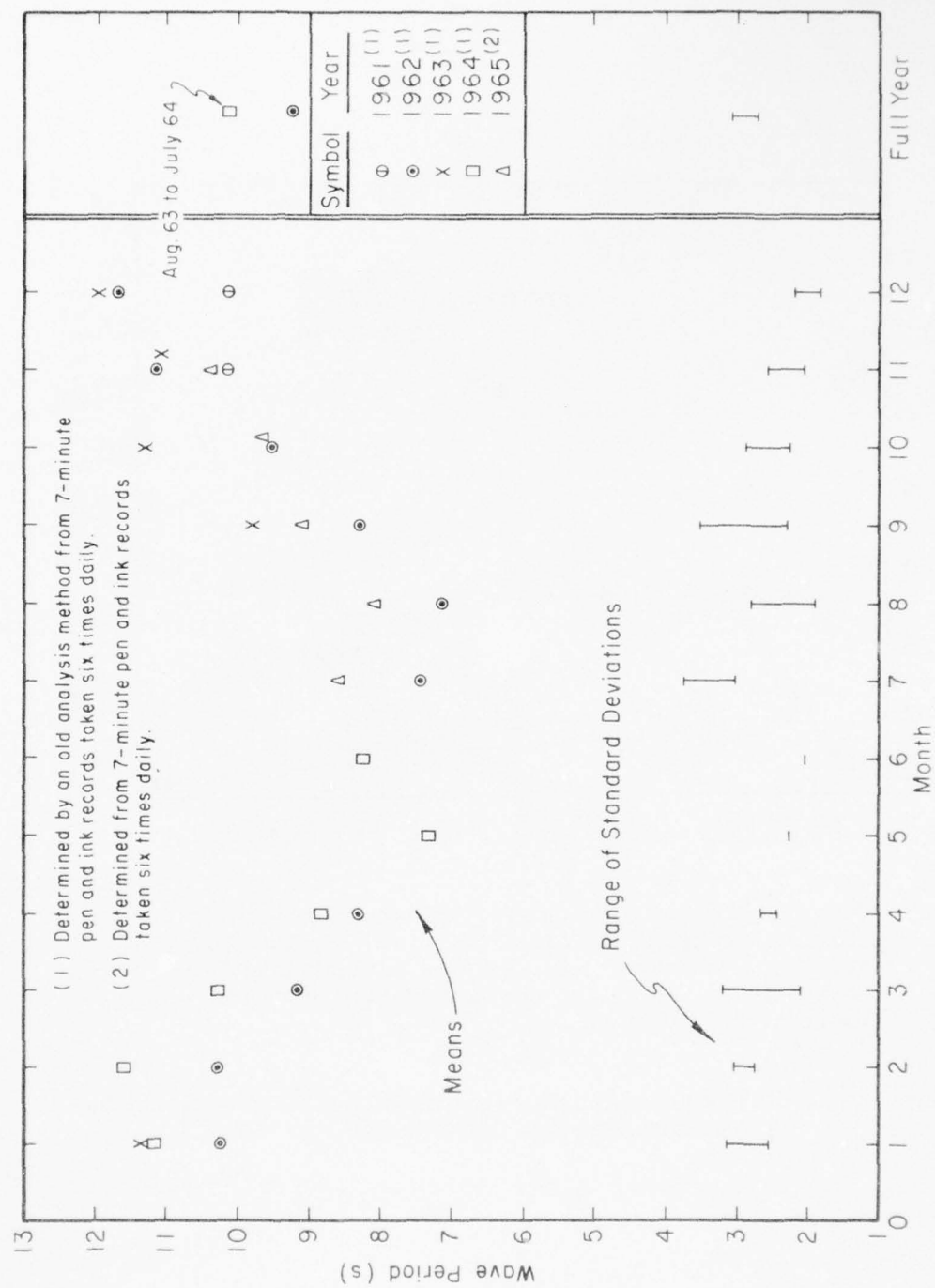


Figure A-84. Means and standard deviations of wave periods for Port Hueneme, California.

AD-A037 904

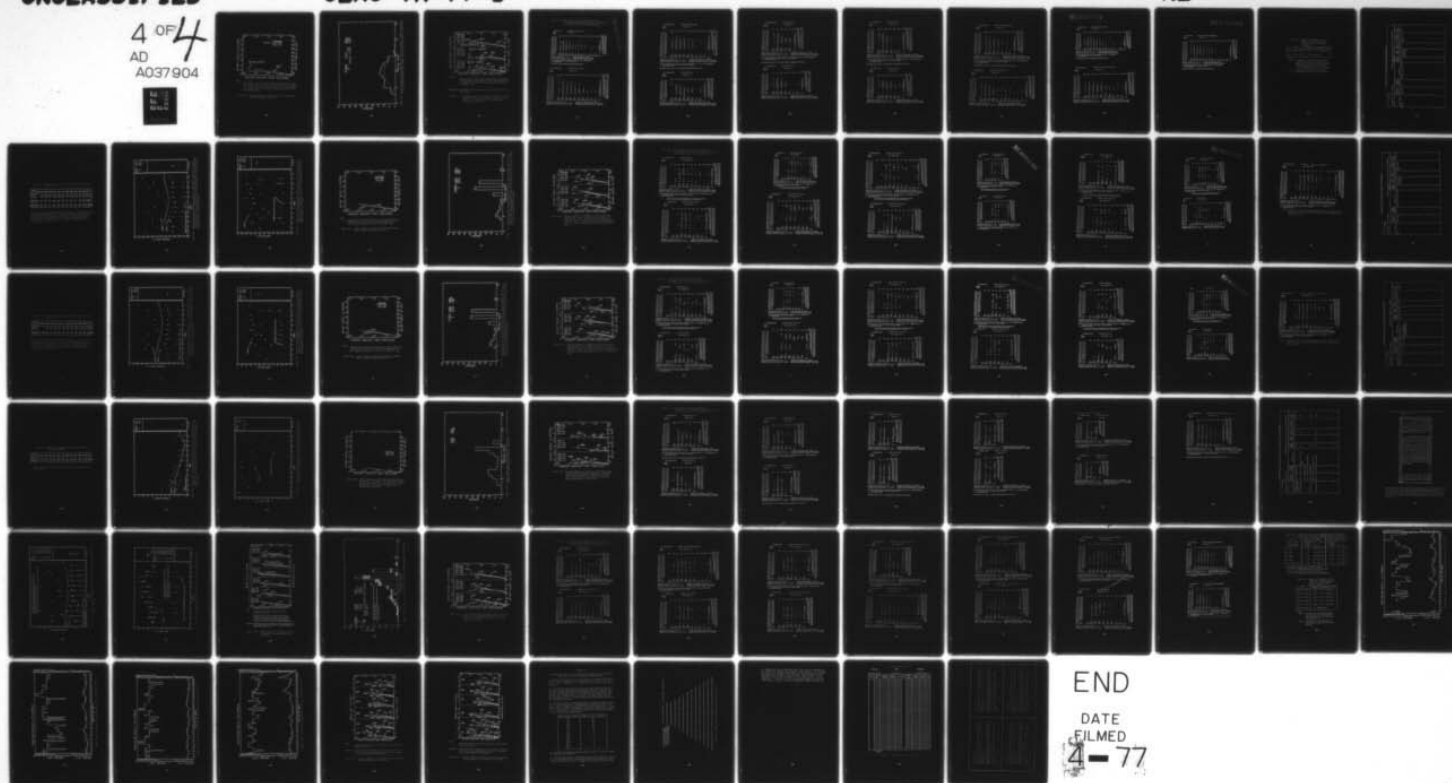
COASTAL ENGINEERING RESEARCH CENTER FORT BELVOIR VA
WAVE CLIMATE AT SELECTED LOCATIONS ALONG U.S. COASTS.(U)
JAN 77 E F THOMPSON
CERC-TR-77-1

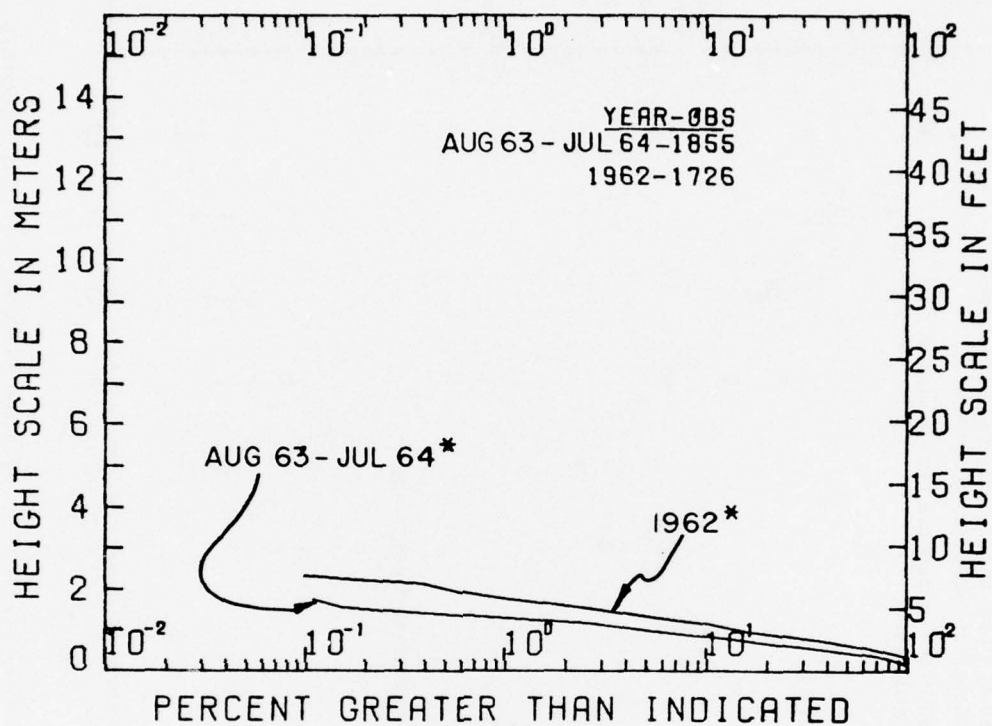
F/G 8/3

UNCLASSIFIED

NL

4 OF 4
AD
A037904

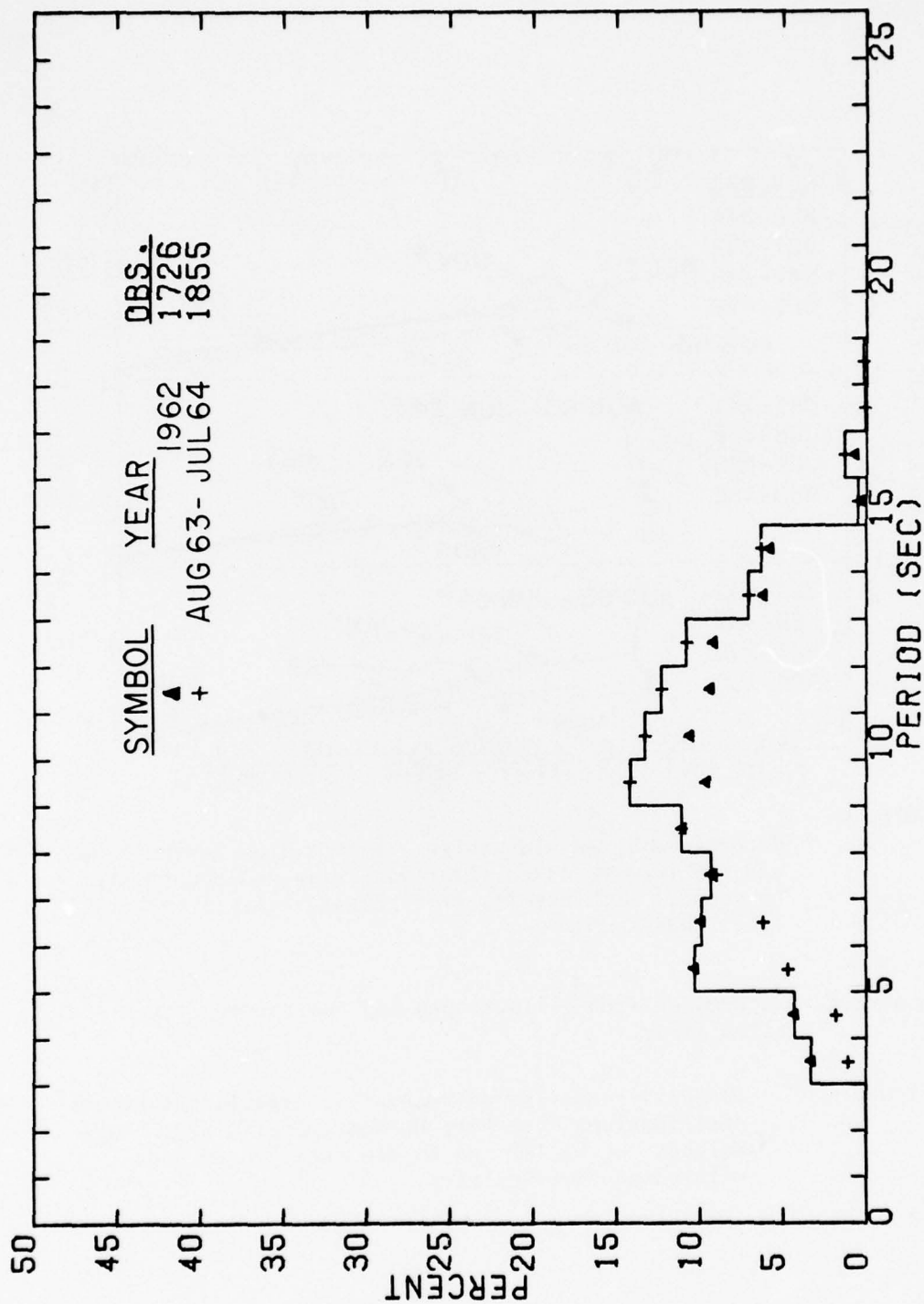


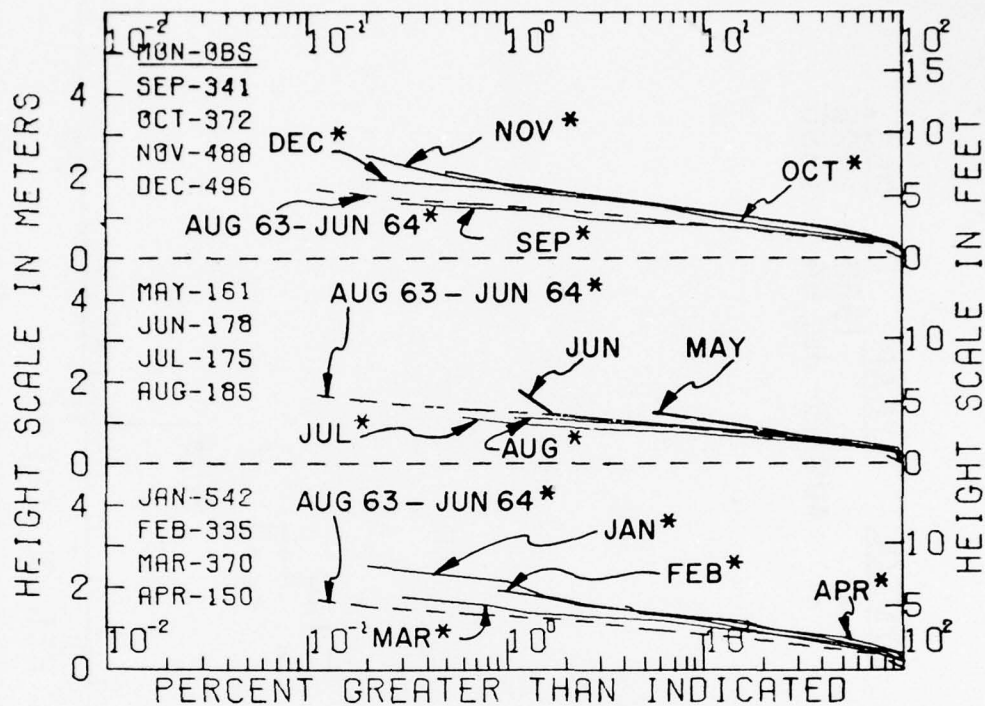


NOTE:

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Table A-55); wave heights may be low due to old gage design and maintenance difficulties.

Figure A-85. Annual cumulative significant height distributions from Port Hueneme, California.





NOTE:

* = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Table A-55).

Unmarked = determined from 7-minute pen and ink records taken six times daily.

Figure A-87. Seasonal summaries of cumulative significant height distributions from Port Hueneme, California. Wave heights may be low due to old gage design and maintenance difficulties.

BEST AVAILABLE COPY

Wave heights may be low due to old gage design and maintenance difficulties.

291

370 OBSERVATIONS

SUMMARY FOR MAR 62 MAR 64

PERIOD
(SECS)

HEIGHT (FT)

	=1.2	=1.8	=2.5	=3.1	=3.7	=4.4	=5.0	=5.7	=6.3	TOT.*	CUM. TOT.*	RD AVG.*
.0 = 1.9	51										1000	.00
2.0 = 2.4											1000	.00
2.5 = 2.9											1000	.00
3.0 = 3.4		3								3	1000	1.50
3.5 = 3.9	3	8								11	997	1.34
4.0 = 4.9		8	19	5						34	986	2.09
5.0 = 5.9		11	19	27	14	11				85	952	2.74
6.0 = 6.9	3	27	14	16	5	5	3			77	866	2.33
7.0 = 7.9	8	30	5	14	5	3		3		71	789	2.14
8.0 = 8.9	14	35	14	16	3	8			3	97	718	2.14
9.0 = 9.9	16	35	38	16	3	5		3		123	621	2.05
10.0 = 10.9	27	27	35	27	14	3				140	499	2.05
11.0 = 11.9	24	32	35	19	5	3	3			128	359	1.97
12.0 = 12.9	27	32	22	14	5	5				111	231	1.86
13.0 = 13.9	16	32	14	8	8	3				85	120	1.88
14.0 = 14.9		5	5	16		3				31	34	2.55
15.0 = 15.9											3	.00
16.0 = 16.9											3	.00
17.0 = 17.9											3	.00
18.0 = 18.9	3									3	3	.86
TOTAL	192	284	219	178	62	49	5	5	3	3		2.04
CUM. TOTAL	1000	808	522	303	124	62	14	8	3			
COL. AVG.	10.87*	9.58	9.57	9.45	9.33	9.00	9.00	8.50	8.50	9.69		

AVERAGE SIG. HEIGHT = 2.04 FT

AVERAGE WAVE PERIOD = 9.69 SEC*

VARIANCE OF SIG. HEIGHT = .91 FT SQ

VARIANCE OF WAVE PERIOD = 7.78 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .95 FT

STANDARD DEVIATION OF PERIOD = 2.79 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR

* CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

150 OBSERVATIONS

SUMMARY FOR APR 62

PERIOD
(SECS)

HEIGHT (FT)

	=1.2	=1.8	=2.5	=3.1	=3.7	=4.4	=5.0	=5.7	TOT.*	CUM. TOT.*	RD AVG.*
.0 = 1.9										1000	.00
2.0 = 2.4										1000	.00
2.5 = 2.9										1000	.00
3.0 = 3.4	20	7							27	1000	1.02
3.5 = 3.9	7	20							27	973	1.34
4.0 = 4.9		87	13						80	947	1.61
5.0 = 5.9		40	20	13					73	867	1.91
6.0 = 6.9		40	13	7	13	13		7	93	793	2.60
7.0 = 7.9		40	47	13	7	7	7		127	700	2.48
8.0 = 8.9		33	13	73	13	40		13	187	573	3.01
9.0 = 9.9		7	53	80	7	20		13	180	387	2.90
10.0 = 10.9		7	13	27	13				60	207	2.64
11.0 = 11.9		13	13	20					47	147	2.23
12.0 = 12.9		7	7	20	7				40	100	2.57
13.0 = 13.9			7	7					13	60	2.46
14.0 = 14.9			7	13	27				47	47	3.05
TOTAL	27	280	207	273	87	80	7	40			2.51
CUM. TOTAL	1000	973	693	487	213	127	47	40			
COL. AVG.	3.37*	6.54	8.66	9.67	10.65	8.33	7.50	8.33	8.33		

AVERAGE SIG. HEIGHT = 2.51 FT

AVERAGE WAVE PERIOD = 8.33 SEC*

VARIANCE OF SIG. HEIGHT = 1.02 FT SQ

VARIANCE OF WAVE PERIOD = 7.24 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.01 FT

STANDARD DEVIATION OF PERIOD = 2.69 SEC*

161 OBSERVATIONS

SUMMARY FOR MAY 64

PERIOD
(SFCS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	RD=	AVG.*
.0 = 1.9							1000	.00	
2.0 = 2.4							1000	.00	
2.5 = 2.9							1000	.00	
3.0 = 3.4	12	19				31	1000	1.10	
3.5 = 3.9	6	37				43	949	1.36	
4.0 = 4.9	6	68	12			87	925	1.57	
5.0 = 5.9	6	99	25			130	839	1.64	
6.0 = 6.9		75	43	12	6	137	708	2.14	
7.0 = 7.9	6	62	81	37	19	205	571	2.50	
8.0 = 8.9		68	37	25	19	149	366	2.46	
9.0 = 9.9	6	50	43	12	12	124	217	2.30	
10.0 = 10.9	6	19	12	6		43	93	1.93	
11.0 = 11.9		19			6	25	50	2.25	
12.0 = 12.9			6			6	25	1.50	
13.0 = 13.9			6			6	19	1.50	
14.0 = 14.9			12			12	12	1.50	
TOTAL	50	540	255	93	62				2.08
CUM. TOTAL	1000	950	410	155	62				
COL. AVG.	5.97*	7.05	7.62	8.10	8.50	7.33			

AVERAGE SIG. HEIGHT = 2.08 FT

AVERAGE WAVE PERIOD = 7.33 SEC*

VARIANCE OF SIG. HEIGHT = .90 FT SQ

VARIANCE OF WAVE PERIOD = 5.01 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .95 FT

STANDARD DEVIATION OF PERIOD = 2.24 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

174 OBSERVATIONS

SUMMARY FOR JUN 64

PERIOD
(SFCS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	RD=	AVG.*
.0 = 1.9									1000	.00	
2.0 = 2.4									1000	.00	
2.5 = 2.9									1000	.00	
3.0 = 3.4									1000	.00	
3.5 = 3.9	6	6						11	1000	1.00	
4.0 = 4.9	17	22	6					45	989	1.25	
5.0 = 5.9		101	17					118	944	1.64	
6.0 = 6.9		79	6					84	826	1.57	
7.0 = 7.9	6	101	39	22				169	742	1.97	
8.0 = 8.9	22	118	45	6			6	197	573	1.81	
9.0 = 9.9	11	101	62	17	6		6	202	376	2.14	
10.0 = 10.9		28	34	17				79	174	2.36	
11.0 = 11.9	6	22	22	11				62	96	2.14	
12.0 = 12.9		22	6					28	34	1.70	
13.0 = 13.9									6	.00	
14.0 = 14.9		6						6	6	1.50	
TOTAL	67	607	236	73	6		11				1.89
CUM. TOTAL	1000	933	326	90	17	11	11				
COL. AVG.	7.44*	7.96	8.90	9.35	9.50	.00	9.00	8.27			

AVERAGE SIG. HEIGHT = 1.89 FT

AVERAGE WAVE PERIOD = 8.27 SEC*

VARIANCE OF SIG. HEIGHT = .78 FT SQ

VARIANCE OF WAVE PERIOD = 4.21 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .88 FT

STANDARD DEVIATION OF PERIOD = 2.05 SEC*

175 OBSERVATIONS

SUMMARY FOR JUL 62

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	46							1000	.00
2.0 - 2.4								1000	.00
2.5 - 2.9								1000	.00
3.0 - 3.4	34	17					54	1000	1.07
3.5 - 3.9	23	23					48	946	1.18
4.0 - 4.9	6	80	11				102	898	1.50
5.0 - 5.9	11	109	46				174	796	1.63
6.0 - 6.9	6	86	17	34	6	6	162	623	2.00
7.0 - 7.9		69	23				96	461	1.66
8.0 - 8.9	11	63	51	17			150	365	1.83
9.0 - 9.9		23	23	6			54	216	1.93
10.0 - 10.9		6	17	6			30	162	2.14
11.0 - 11.9	6	11	6				24	132	1.50
12.0 - 12.9		11					12	108	1.50
13.0 - 13.9		6	6				12	96	1.62
14.0 - 14.9		57	6	6			72	84	1.66
15.0 - 15.9		6					6	12	1.50
16.0 - 16.9		6					6	6	1.50
TOTAL	143	571	206	69	6	6			1.65
CUM. TOTAL	1000	857	286	80	11	6			
COL. AVG.	5.00*	7.60	8.00	8.25	6.50	6.50	7.46		

AVERAGE SIG. HEIGHT = 1.65 FT

AVERAGE WAVE PERIOD = 7.46 SEC*

VARIANCE OF SIG. HEIGHT = .29 FT SQ

VARIANCE OF WAVE PERIOD = 9.56 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .54 FT

STANDARD DEVIATION OF PERIOD = 3.09 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

* WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR

* CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

185 OBSERVATIONS

SUMMARY FOR AUG 62

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	TOT.*	CUM. TOT.*	NO. AVG.*
0.0 - 1.9	11							1000	.00
2.0 - 2.4								1000	.00
2.5 - 2.9								1000	.00
3.0 - 3.4	11						11	1000	.86
3.5 - 3.9		22					22	989	1.50
4.0 - 4.9	5	38	16	5			66	967	1.71
5.0 - 5.9	11	65	114	38			230	902	2.00
6.0 - 6.9	5	103	16	32		5	164	672	1.88
7.0 - 7.9		70	54	16	16	5	164	508	2.12
8.0 - 8.9	5	59	81	43	16		208	344	2.16
9.0 - 9.9	5	27	27	27			87	137	2.06
10.0 - 10.9			5	11	5		22	49	2.78
11.0 - 11.9			5				5	27	2.14
12.0 - 12.9		11	5				16	22	1.71
13.0 - 13.9								5	.00
14.0 - 14.9								5	.00
15.0 - 15.9			5				5	5	2.14
TOTAL	54	395	330	173	38	11			2.00
CUM. TOTAL	1000	946	551	222	49	11			
COL. AVG.	5.81*	6.84	7.35	7.53	8.36	7.00	7.15		

AVERAGE SIG. HEIGHT = 2.00 FT

AVERAGE WAVE PERIOD = 7.15 SEC*

VARIANCE OF SIG. HEIGHT = .40 FT SQ

VARIANCE OF WAVE PERIOD = 3.65 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .63 FT

STANDARD DEVIATION OF PERIOD = 1.91 SEC*

341 OBSERVATIONS

SUMMARY FOR SEP 62 SEP 63

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	5.0	TOT.*	CUM. TOT.*	ROW AVG.*
1.0 = 1.9	21								1000	.00
2.0 = 2.4									1000	.00
2.5 = 2.9									1000	.00
3.0 = 3.4	6	9						15	1000	1.24
3.5 = 3.9	9	9						18	985	1.18
4.0 = 4.9	9	15	9					33	967	1.50
5.0 = 5.9	26	41	18	9				96	934	1.56
6.0 = 6.9	9	32	23	18				84	838	1.89
7.0 = 7.9	21	53	15	15	3			108	754	1.70
8.0 = 8.9	15	53	44	41	3	6		165	647	2.07
9.0 = 9.9	15	73	26	12	6			135	482	1.76
10.0 = 10.9	9	62	15	6				93	347	1.62
11.0 = 11.9	15	47	23	9				96	254	1.68
12.0 = 12.9	6	50	23	9		3		93	159	1.83
13.0 = 13.9	6	18	3	3				30	66	1.56
14.0 = 14.9	3	18	9				3	33	36	1.91
15.0 = 15.9						3		3	3	4.06
TOTAL	167	478	208	120	12	12	3			1.74
CUM. TOTAL	1000	833	555	147	26	15	3			
COL. AVG.	7.96*	9.22	9.16	8.70	8.75	11.25	14.50	8.99		

AVERAGE SIG. HEIGHT = 1.74 FT

AVERAGE WAVE PERIOD = 8.99 SEC*

VARIANCE OF SIG. HEIGHT = .44 FT SQ

VARIANCE OF WAVE PERIOD = 7.35 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .67 FT

STANDARD DEVIATION OF PERIOD = 2.71 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

372 OBSERVATIONS

SUMMARY FOR OCT 62 OCT 63

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	5.0	5.7	6.3	6.9	7.6	TOT.*	CUM. TOT.*	ROW AVG.*
1.0 = 1.9	5												1000	.00
2.0 = 2.4													1000	.00
2.5 = 2.9													1000	.00
3.0 = 3.4	5	3										8	1000	1.07
3.5 = 3.9		5										5	992	1.50
4.0 = 4.9	5											5	986	.86
5.0 = 5.9	13	22	19	3								57	981	1.62
6.0 = 6.9	3	51	8									62	924	1.56
7.0 = 7.9	13	38	13				5					70	862	1.75
8.0 = 8.9	3	15	13	11	3	5						70	792	2.07
9.0 = 9.9		54	30	5	11	5		8				114	722	2.31
10.0 = 10.9	8	70	30	24	5	11	13	5				170	608	2.45
11.0 = 11.9	3	59	35	16	11		3				3	130	438	2.17
12.0 = 12.9	3	43	46	24				3	3	3		124	308	2.27
13.0 = 13.9	3	27	40	19	3		3					95	184	2.16
14.0 = 14.9	13	22	19	3	11	3						70	89	1.99
15.0 = 15.9		5										5	19	1.50
16.0 = 16.9	3		5	3			3					14	14	2.52
TOTAL	81	433	258	108	43	24	27	16	3	3	5			2.10
CUM. TOTAL	1000	919	487	228	121	78	54	27	11	8	5			
COL. AVG.	9.05*	9.89	11.01	11.50	11.56	10.28	10.90	10.33	12.50	12.50	11.00	10.43		

AVERAGE SIG. HEIGHT = 2.10 FT

AVERAGE WAVE PERIOD = 10.43 SEC*

VARIANCE OF SIG. HEIGHT = 1.04 FT SQ

VARIANCE OF WAVE PERIOD = 7.53 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.04 FT

STANDARD DEVIATION OF PERIOD = 2.74 SEC*

BEST AVAILABLE COPY

486 OBSERVATIONS

SUMMARY FOR NOV 01 NOV 02 NOV 03

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	5.0	5.7	6.3	6.9	7.6	8.2	8.9	TOT.	CUM.	ROW
1.0 - 1.9	2														1000	.00
2.0 - 2.9															1000	.00
3.0 - 3.9															1000	.00
4.0 - 4.9															1000	.00
5.0 - 5.9															1000	.00
6.0 - 6.9															1000	.00
7.0 - 7.9															1000	.00
8.0 - 8.9															1000	.00
9.0 - 9.9															1000	.00
10.0 - 10.9															1000	.00
11.0 - 11.9															1000	.00
12.0 - 12.9															1000	.00
13.0 - 13.9															1000	.00
14.0 - 14.9															1000	.00
15.0 - 15.9															1000	.00
16.0 - 16.9															1000	.00
TOTAL	76	227	254	236	98	53	31	10	6	2	2	2	2	2	1000	1.71
CUM. TOTAL	1000	924	697	443	207	109	55	25	14	6	6	2	2	2	1000	2.50
COL. AVG.	10.39	10.97	10.43	11.40	11.33	11.38	11.70	12.40	7.25	11.50	11.50	.66	13.88	10.00		

AVERAGE SIG. HEIGHT = 2.05 FT AVERAGE WAVE PERIOD = 10.88 SEC
 VARIANCE OF SIG. HEIGHT = 1.18 FT SQ VARIANCE OF WAVE PERIOD = 5.71 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.09 FT STANDARD DEVIATION OF PERIOD = 2.39 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEEP RESISTANCE
 WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

496 OBSERVATIONS

SUMMARY FOR DEC 01 DEC 02 DEC 03

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.8	2.5	3.1	3.7	4.4	5.0	5.7	6.3	6.9	TOT.	CUM.	ROW
1.0 - 1.9	54											1000	.00
2.0 - 2.9												1000	.00
3.0 - 3.9												1000	.00
4.0 - 4.9												1000	.00
5.0 - 5.9												1000	.00
6.0 - 6.9												1000	.00
7.0 - 7.9												1000	.00
8.0 - 8.9												1000	.00
9.0 - 9.9												1000	.00
10.0 - 10.9												1000	.00
11.0 - 11.9												1000	.00
12.0 - 12.9												1000	.00
13.0 - 13.9												1000	.00
14.0 - 14.9												1000	.00
15.0 - 15.9												1000	.00
16.0 - 16.9												1000	.00
TOTAL	93	286	230	190	105	50	28	10	6	2	2	1000	2.57
CUM. TOTAL	1000	907	621	391	202	97	46	18	8	2	2	1000	2.57
COL. AVG.	10.76	11.30	11.43	11.01	10.90	11.46	11.64	10.90	8.17	9.50	11.20		

AVERAGE SIG. HEIGHT = 2.33 FT AVERAGE WAVE PERIOD = 11.20 SEC
 VARIANCE OF SIG. HEIGHT = 1.09 FT SQ VARIANCE OF WAVE PERIOD = 4.78 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.04 FT STANDARD DEVIATION OF PERIOD = 2.19 SEC

BEST AVAILABLE COPY

1454 OBSERVATIONS

SUMMARY FOR 20 MONTHS NOV 61 THROUGH MAR 64

PERIOD
(SECS)

HEIGHT (FT)

	1.2	1.0	2.5	3.1	3.7	4.4	5.0	5.7	6.3	6.9	7.6	8.2	8.9	TOT.	CUM. TOT.	AVG.
1.0 - 1.9	45														1000	1.00
2.0 - 2.9															1000	1.00
3.0 - 3.9															1000	1.00
4.0 - 4.9															1000	1.11
5.0 - 5.9															10	492 1.14
6.0 - 6.9															24	462 1.09
7.0 - 7.9															66	458 1.97
8.0 - 8.9															70	492 2.00
9.0 - 9.9															68	422 1.97
10.0 - 10.9															95	754 2.29
11.0 - 11.9															121	659 2.25
12.0 - 12.9															139	538 2.39
13.0 - 13.9															124	399 2.29
14.0 - 14.9															115	275 2.28
15.0 - 15.9															74	160 2.30
16.0 - 16.9															67	85 2.31
17.0 - 17.9															5	18 1.95
18.0 - 18.9															12	13 2.34
TOTAL	133	338	221	162	63	44	20	10	4	2	2	1	1	1	1	2.18
CUM. TOTAL	1000	867	529	307	145	82	38	18	8	4	3	1	1	1	1	
COL. AVG.	9.56	9.70	10.06	10.33	10.87	10.83	11.39	10.50	9.21	12.00	12.00	10.50	12.50	10.00		

AVERAGE SIG. HEIGHT = 2.13 FT AVERAGE WAVE PERIOD = 10.06 SECS
 VARIANCE OF SIG. HEIGHT = 1.06 FT SQ VARIANCE OF WAVE PERIOD = 0.40 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.03 FT STANDARD DEVIATION OF PERIOD = 2.00 SECS

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STYP RESISTANCE
 WAVE GAGE LOCATED NEAR VENTURA COUNTY HARBOR
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

Table A-55. Regression equations used to compensate significant height statistics for Port Hueneme, California.

Date	Compensation equations (ft)
1961 to Mar. 1964	$H_{NEW} = 0.54 + 0.64 H_{OLD}$
Apr. 1964 to 1965	No compensation

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis (based on reanalysis of 2 months of data from Huntington Beach, California)

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

Table A-56. CERC wave gage history for Pt. Mugu, California (Gage No. 3).

CERC Form 174-74
18 Mar 74

COORDINATES: 34°07' N., 119°09' W.

LOCATION: Three miles southeast of Port Hueneme, Pt. Mugu, California
(Gage No. 3)

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Pressure	27 Mar. 1970		Still operative as of 1 Jan. 1975	---	-11 to +19 (mounted 29 ft below MSL)	31	1,300 feet from shore.	---

Table A-57. Number of analyzed records from Pt. Mugu, California
(Gage No. 3).¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1972		107	123	93	100	118	96	111	106	118	62	85	1119
1973	33	78	65	62	66	86	66	84	86	81	106	53	866
1974	100	99	92	71	99	96	88	79	56	74	99	84	1037

¹From 1,024-second records taken four times daily. Results from records taken before January 1973 have not been compensated for hydrodynamic attenuation due to submergence of the gage. Results taken during January 1973 to December 1974 may have been overcompensated such that significant heights are up to 20 percent too high and wave periods tend to be too short.

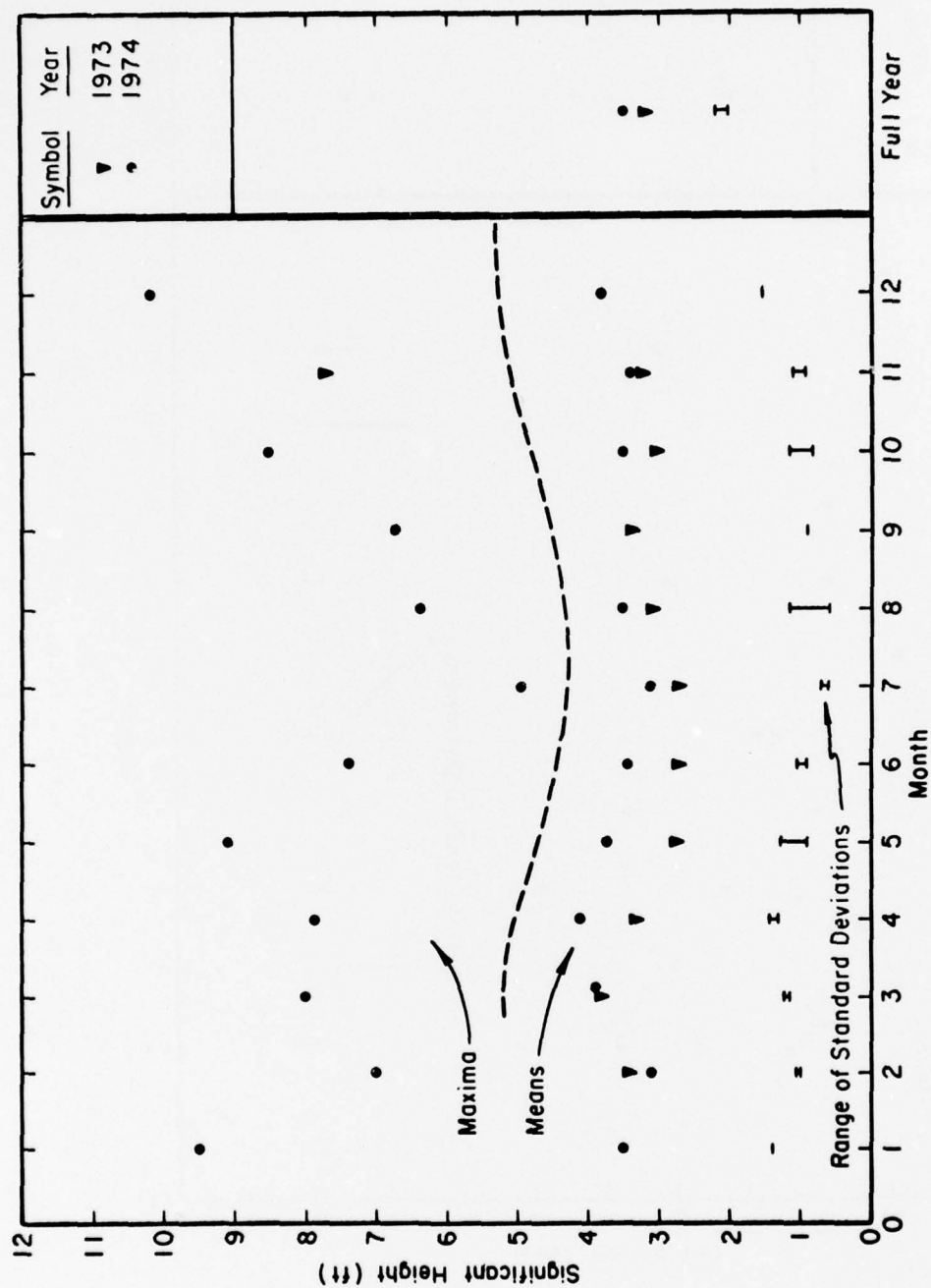


Figure A-88. Maxima, means, and standard deviations of significant height from Pt. Mugu, California (Gage No. 3). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that significant heights are up to 20 percent too high.

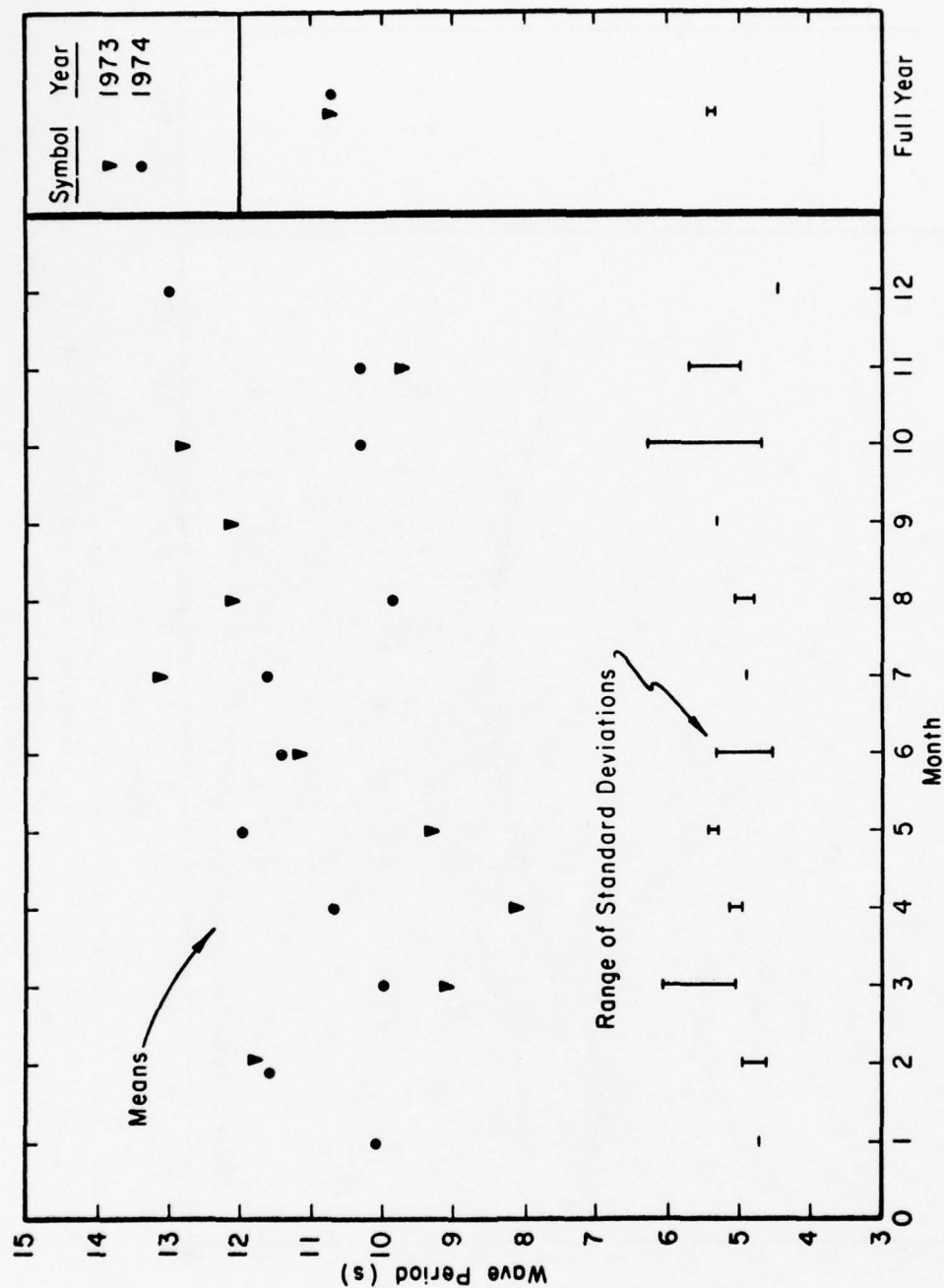
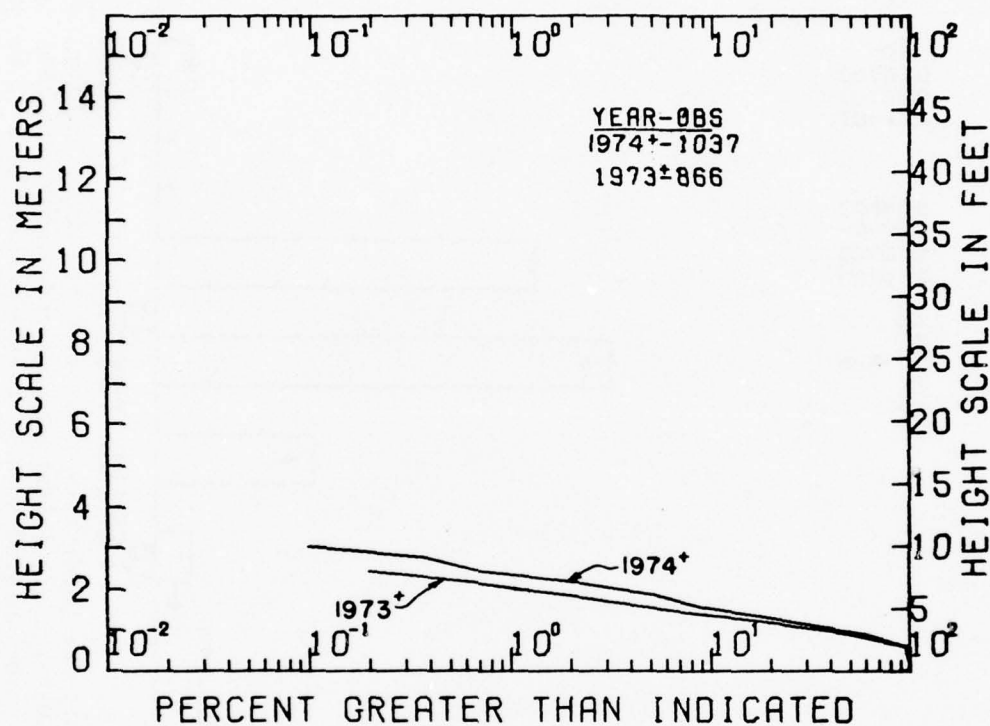


Figure A-89. Means and standard deviations of wave periods for Pt. Mugu, California (Gage No. 3). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that wave periods tend to be too short.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily; results may have been overcompensated such that significant heights are up to 20 percent high.

Figure A-90. Annual cumulative significant height distributions from Pt. Mugu, California (Gage No. 3).

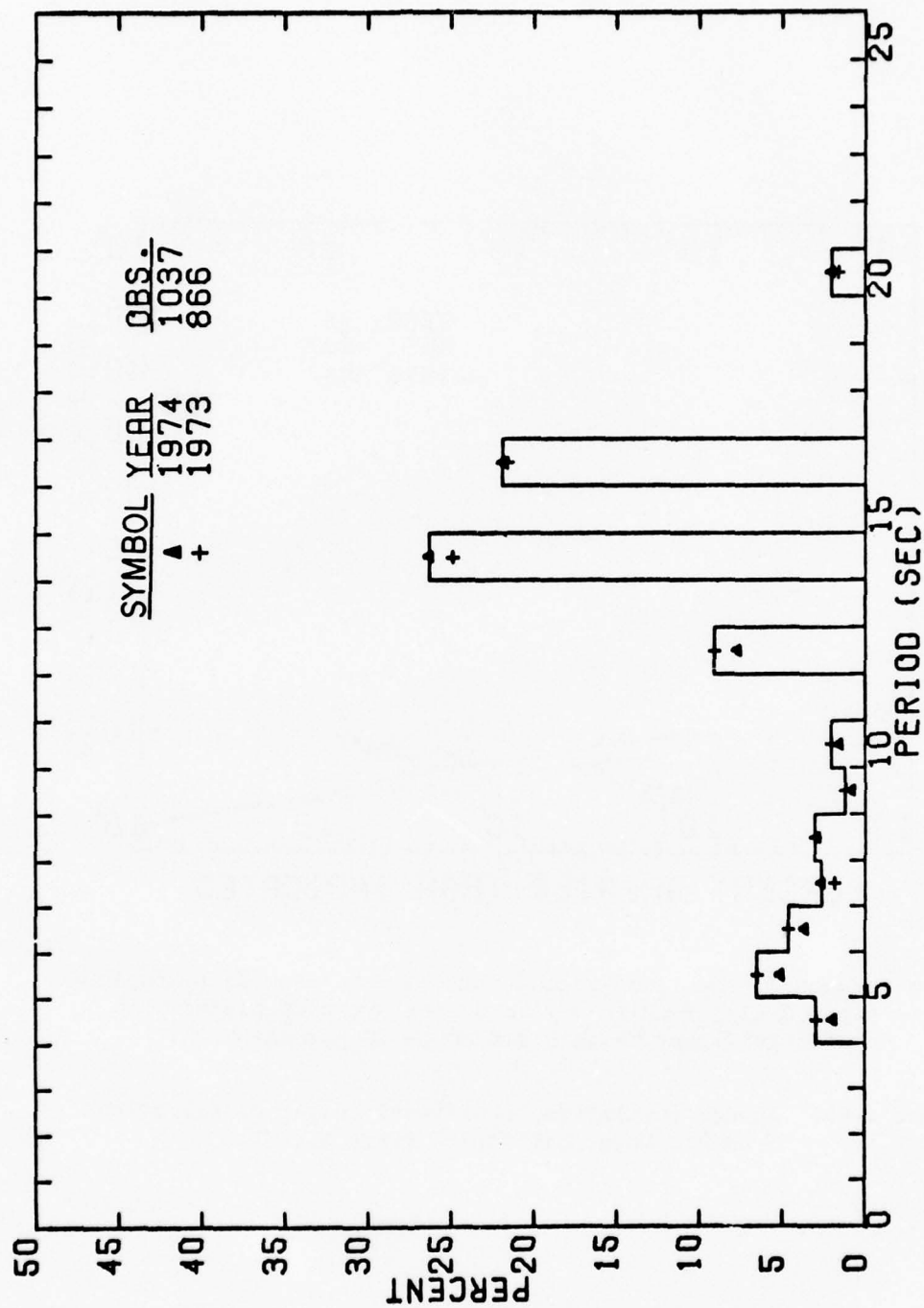


Figure A-91. Annual significant period distributions from Pt. Mugu, California (Gage No. 3).
 Computed from 1,024-second digital wave records taken four times daily. Results
 may have been overcompensated such that wave periods tend to be too short; periods
 less than 4 seconds have been omitted.

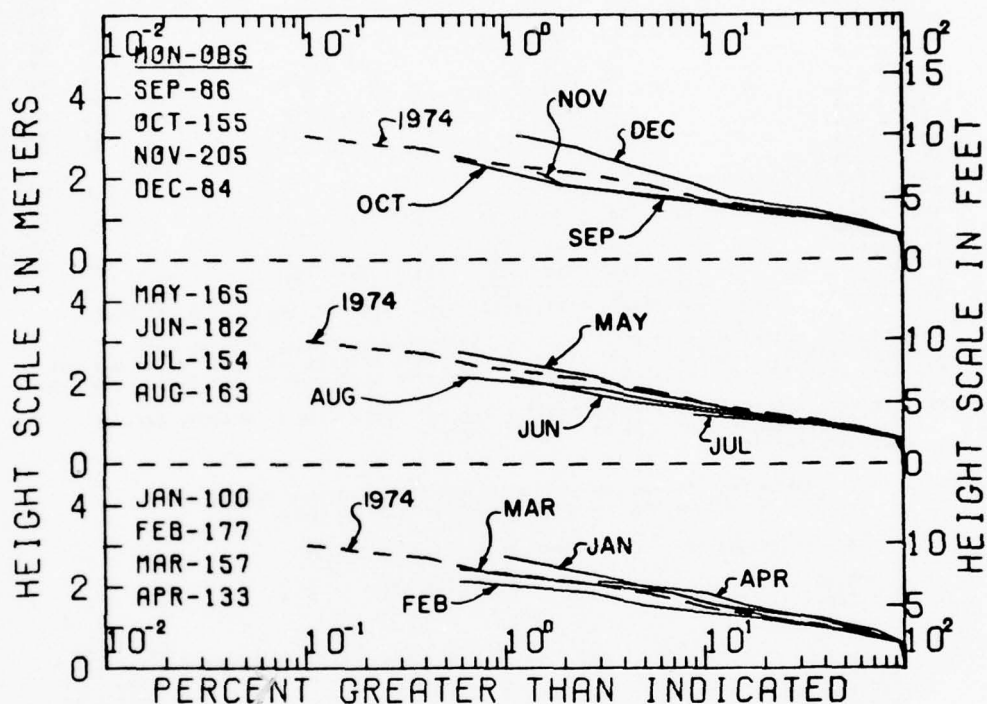


Figure A-92. Seasonal summaries of cumulative significant height distributions from Pt. Mugu, California (Gage No. 3). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that significant heights are up to 20 percent too high.

Table A-58. Wave climate for Pt. Mugu, California.
Distribution of significant height versus period
(in observations per 1,000 observations).

100 OBSERVATIONS											SUMMARY FOR JAN 74		
PERIOD (SECS)	SIG. HEIGHT (FT)												
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9		10	100	60		10					180	1000	2.94
4.0 = 4.9				20	10						30	820	3.83
5.0 = 5.9			10	20			10				40	790	4.00
6.0 = 6.9			10	10				10			30	750	4.50
7.0 = 7.9			30	20	20	10					80	720	3.63
8.0 = 8.9			20	50		10	10	10		10	110	640	4.68
9.0 = 9.9			10					10			20	530	5.00
10.0 = 10.9			20								20	510	2.50
11.0 = 11.9												490	0.00
12.0 = 12.9		20	60	20							100	490	2.50
13.0 = 13.9												390	0.00
14.0 = 14.9		20	80	70	70	20	10				270	390	3.57
15.0 = 15.9												120	0.00
16.0 = 16.9			80	30	10						120	120	2.92
TOTAL		50	420	300	110	50	30	30		10			3.86
CUM. TOTAL	1000	1000	950	530	230	120	70	40	10	10			
COL. AVG.	0.00	11.50	10.48	9.37	12.50	9.70	9.50	8.17	0.00	8.50	10.28		

AVERAGE SIG. HEIGHT = 3.47 FT AVERAGE WAVE PERIOD = 10.06 SEC
VARIANCE OF SIG. HEIGHT = 1.97 FT SQ VARIANCE OF WAVE PERIOD = 21.99 SEC SQ
STANDARD DEVIATION OF HEIGHT = 1.40 FT STANDARD DEVIATION OF PERIOD = 4.69 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)
WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.
* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights
are up to 20% too high and wave periods tend to be too short.

177 OBSERVATIONS											SUMMARY FOR FEB 73 FEB 74		
PERIOD (SECS)	SIG. HEIGHT (FT)												
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW AVG.*		
0.0 = .9										1000	0.00		
1.0 = 1.9										1000	0.00		
2.0 = 2.9										1000	0.00		
3.0 = 3.9		6	96	28	6				136	1000	2.75		
4.0 = 4.9		6	6	6	6				23	864	3.00		
5.0 = 5.9			6	11	11		6		34	842	4.17		
6.0 = 6.9				11		6	6	6	28	808	5.30		
7.0 = 7.9			6	23			6		34	780	3.83		
8.0 = 8.9			23	11	17		6		56	746	3.70		
9.0 = 9.9				11	6	6			23	689	4.25		
10.0 = 10.9			11	17					28	667	3.10		
11.0 = 11.9										638	0.00		
12.0 = 12.9		6	68	11	6				90	638	2.69		
13.0 = 13.9										548	0.00		
14.0 = 14.9		17	147	85	51				299	548	3.07		
15.0 = 15.9										249	0.00		
16.0 = 16.9			102	79	40	11			232	249	3.33		
17.0 = 17.9										17	0.00		
18.0 = 18.9										17	0.00		
19.0 = 19.9										17	0.00		
20.0 = 20.9				11	6				17	17	3.17		
21.0 +											0.00		
TOTAL		34	475	294	147	23	23	6			3.24		
CUM. TOTAL	1000	1000	966	492	198	51	28	6					
COL. AVG.	0.00	10.67	11.87	11.87	12.81	12.25	7.00	6.50	11.83				

AVERAGE SIG. HEIGHT = 3.23 FT AVERAGE WAVE PERIOD = 11.69 SEC
VARIANCE OF SIG. HEIGHT = 1.01 FT SQ VARIANCE OF WAVE PERIOD = 23.20 SEC SQ
STANDARD DEVIATION OF HEIGHT = 1.00 FT STANDARD DEVIATION OF PERIOD = 4.82 SEC

137 OBSERVATIONS										SUMMARY FOR MAR 73 MAR 74		
PERIOD (SECS)										SIG. HEIGHT (FT)		
0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.	CUM. TOT.	ROW	AVG.
0.0 = .0										1000	0.00	
1.0 = 1.0										1000	0.00	
2.0 = 2.0										1000	0.00	
3.0 = 3.0										1000	0.00	
4.0 = 4.0			97	108	51	13	13	6		1000	3.83	
5.0 = 5.0				32	19	13				64	752	4.20
6.0 = 6.0				6	25	97	13	19		121	608	4.61
7.0 = 7.0					13	6	6	6		38	567	5.67
8.0 = 8.0					6	13	6			32	529	3.00
9.0 = 9.0						6				13	497	4.00
10.0 = 10.0							6			13	484	5.50
11.0 = 11.0											471	0.00
12.0 = 12.0											471	0.00
13.0 = 13.0											471	0.00
14.0 = 14.0											414	0.00
15.0 = 15.0											414	5.23
16.0 = 16.0											204	0.00
17.0 = 17.0											204	3.50
18.0 = 18.0											38	0.00
19.0 = 19.0											38	0.00
20.0 = 20.0											38	0.00
21.0 =											38	2.83
TOTAL												5.84
CUM. TOTAL	1000	1000	994	739	589	121	70	19	6			
COL. AVG.	0.00	14.50	12.50	9.32	9.38	6.13	6.50	9.00	6.50	9.82		

AVERAGE SIG. HEIGHT = 3.85 FT AVERAGE WAVE PERIOD = 9.63 SEC
 VARIANCE OF SIG. HEIGHT = 1.37 FT SQ VARIANCE OF WAVE PERIOD = 32.18 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.17 FT STANDARD DEVIATION OF PERIOD = 5.67 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.
 * CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

133 OBSERVATIONS									SUMMARY FOR APR 73 APR 74		
PERIOD (SECS)									SIG. HEIGHT (FT)		
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9										1000	0.00
3.0 = 3.9		15	128	30	30	8			211	1000	2.96
4.0 = 4.9			8	8	8	8			30	789	4.00
5.0 = 5.9			8	15	38	15	38	15	128	759	5.32
6.0 = 6.9				8	53	30	23	15	128	632	5.38
7.0 = 7.9				15	15		15		45	504	4.83
8.0 = 8.9				8	8				15	459	4.00
9.0 = 9.9										444	0.00
10.0 = 10.9										444	0.00
11.0 = 11.9										444	0.00
12.0 = 12.9		8	8	23	8				45	444	3.17
13.0 = 13.9										398	0.00
14.0 = 14.9		8	90	113	15				226	398	3.10
15.0 = 15.9										173	0.00
16.0 = 16.9			90	53	23				165	173	3.09
17.0 = 17.9										8	0.00
18.0 = 18.9										8	0.00
19.0 = 19.9										8	0.00
20.0 = 20.9										8	2.50
21.0 +			8						8		0.00
TOTAL		30	338	271	195	60	75	30			3.76
CUM. TOTAL	1000	1000	970	632	361	165	105	30			
COL. AVG.	0.00*	8.50	10.54	11.04	7.92	5.63	6.20	6.00	9.99		
AVERAGE SIG. HEIGHT = 3.72 FT											
VARIANCE OF SIG. HEIGHT = 1.98 FT SQ											
STANDARD DEVIATION OF HEIGHT = 1.41 FT											
AVERAGE WAVE PERIOD = 9.47 SEC*											
VARIANCE OF WAVE PERIOD = 27.06 SEC SQ*											
STANDARD DEVIATION OF PERIOD = 5.20 SEC*											

AVERAGE SIG. HEIGHT = 3.72 FT AVERAGE WAVE PERIOD = 9.47 SEC
 VARIANCE OF SIG. HEIGHT = 1.98 FT SQ VARIANCE OF WAVE PERIOD = 27.08 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.41 FT STANDARD DEVIATION OF PERIOD = 5.20 SEC

165 OBSERVATIONS

SUMMARY FOR MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9			170	36	12	6					224	1000	2.85
4.0 = 4.9			6	18		6					30	776	3.70
5.0 = 5.9			18		12	6	6			6	48	745	4.75
6.0 = 6.9			6		24	6	6	12			55	697	5.28
7.0 = 7.9								12			12	642	7.50
8.0 = 8.9				12	6	6					24	630	4.25
9.0 = 9.9				6							6	606	3.50
10.0 = 10.9			6								6	600	2.50
11.0 = 11.9												594	0.00
12.0 = 12.9		18	18	30							67	594	2.68
13.0 = 13.9												527	0.00
14.0 = 14.9			115	115	18	12					261	527	3.22
15.0 = 15.9												267	0.00
16.0 = 16.9			133	91	18	6					248	267	3.09
17.0 = 17.9												18	0.00
18.0 = 18.9												18	0.00
19.0 = 19.9												18	0.00
20.0 = 20.9												18	3.83
21.0 =				12	6						18	18	0.00
TOTAL		18	473	321	97	48	12	24		6			3.35
CUM. TOTAL	1000	1000	982	509	188	91	42	30	6	6			
COL. AVG.	0.00	12.50	10.41	12.97	10.38	9.25	6.00	7.00	0.00	5.50	11.05		

AVERAGE SIG. HEIGHT = 3.34 FT

AVERAGE WAVE PERIOD = 10.88 SEC*

VARIANCE OF SIG. HEIGHT = 1.43 FT SQ

VARIANCE OF WAVE PERIOD = 30.26 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.20 FT

STANDARD DEVIATION OF PERIOD = 5.50 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)

WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME,

* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

182 OBSERVATIONS

SUMMARY FOR JUN 73 JUN 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9										1000	0.00
3.0 = 3.9		27	71	60			11	11	181	1000	3.23
4.0 = 4.9				5					5	819	3.50
5.0 = 5.9			5	27	22	5			60	813	3.95
6.0 = 6.9				5	16	11			33	793	4.67
7.0 = 7.9				5		5			11	720	4.50
8.0 = 8.9			5	5	5				16	709	3.50
9.0 = 9.9				11					11	692	3.50
10.0 = 10.9		5	5	11					22	681	2.75
11.0 = 11.9										659	0.00
12.0 = 12.9		27	77	38					143	659	2.58
13.0 = 13.9										516	0.00
14.0 = 14.9		11	203	55	16				286	516	2.77
15.0 = 15.9										231	0.00
16.0 = 16.9			5	88	104	33			231	231	3.21
TOTAL		77	456	330	93	22	11	11			3.10
CUM. TOTAL	1000	1000	923	467	137	44	22	11			
COL. AVG.	0.00	9.71	12.60	11.32	11.32	6.50	3.50	3.50	11.50		

AVERAGE SIG. HEIGHT = 3.08 FT

AVERAGE WAVE PERIOD = 11.32 SEC*

VARIANCE OF SIG. HEIGHT = 1.01 FT SQ

VARIANCE OF WAVE PERIOD = 24.68 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.01 FT

STANDARD DEVIATION OF PERIOD = 4.97 SEC*

BEST AVAILABLE COPY

194 OBSERVATIONS										SUMMARY FOR JUL 73 JUL 74									
PERIOD (SECS)										SIG. HEIGHT (FT)									
0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.	CUM.	NO.	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.	CUM.	NO.
0.0 = 1.0								1000	0.00								1000	0.00	
1.0 = 1.0								1000	0.00								1000	0.00	
2.0 = 2.0								1000	0.00								1000	0.00	
3.0 = 3.0		6	63	26	39		136	1000	3.21								136	864	3.50
4.0 = 4.0				13			13	864	3.50								13	864	3.50
5.0 = 5.0				15	19		34	851	3.63								34	851	3.63
6.0 = 6.0				19			19	799	2.50								19	799	2.50
7.0 = 7.0				0			0	779	1.50								0	779	1.50
8.0 = 8.0				13			13	766	2.50								13	766	2.50
9.0 = 9.0				13			13	753	2.50								13	753	2.50
10.0 = 10.0				0			0	740	2.50								0	740	2.50
11.0 = 11.0								738	0.00									738	0.00
12.0 = 12.0				117	19		136	734	2.04								136	734	2.04
13.0 = 13.0								587	0.00									587	0.00
14.0 = 14.0		19	169	117			305	507	2.82								305	507	2.82
15.0 = 15.0								292	0.00									292	0.00
16.0 = 16.0				104	123	26	253	292	3.19								253	292	3.19
17.0 = 17.0								39	0.00									39	0.00
18.0 = 18.0								39	0.00									39	0.00
19.0 = 19.0				32	6		39	39	2.67								39	39	2.67
20.0 = 20.0								0	0.00									0	0.00
21.0 =								2.98											
TOTAL		26	558	325	91														
CUM. TOTAL	1000	1000	974	816	91														
COL. AVG.	0.00	11.75	12.65	13.48	7.93														

AVERAGE SIG. HEIGHT = 2.93 FT
 VARIANCE OF SIG. HEIGHT = .84 FT SQ
 STANDARD DEVIATION OF HEIGHT = .86 FT
 AVERAGE WAVE PERIOD = 12.28 SECS
 VARIANCE OF WAVE PERIOD = 24.35 SEC SQ
 STANDARD DEVIATION OF PERIOD = 4.93 SECS

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME,
 * CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

192 OBSERVATIONS										SUMMARY FOR AUG 73 AUG 74									
PERIOD (SECS)										SIG. HEIGHT (FT)									
0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.	CUM.	NO.	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.	CUM.	NO.
0.0 = 1.0								1000	0.00								1000	0.00	
1.0 = 1.0								1000	0.00								1000	0.00	
2.0 = 2.0								1000	0.00								1000	0.00	
3.0 = 3.0			31	86	37	29	19	198	4.10								198	802	4.22
4.0 = 4.0			6	31	19	6		12	802	4.22							12	802	4.22
5.0 = 5.0			6	31	19	6		62	790	3.92							62	790	3.92
6.0 = 6.0				6	18		6	25	728	4.75							25	728	4.75
7.0 = 7.0				6				0	704	3.52							0	704	3.52
8.0 = 8.0				6				0	698	2.50							0	698	2.50
9.0 = 9.0			25					25	691	2.50							25	691	2.50
10.0 = 10.0			19	12	6			37	667	3.17							37	667	3.17
11.0 = 11.0									630	0.00								630	0.00
12.0 = 12.0			86	37	12			136	630	2.45							136	630	2.45
13.0 = 13.0									494	0.00								494	0.00
14.0 = 14.0		6	167	168				321	494	2.94							321	494	2.94
15.0 = 15.0									173	0.00								173	0.00
16.0 = 16.0			68	68	19			154	173	3.16							154	173	3.16
17.0 = 17.0									19	0.00								19	0.00
18.0 = 18.0									19	0.00								19	0.00
19.0 = 19.0									19	0.00								19	0.00
20.0 = 20.0									19	3.52								19	3.52
21.0 =									0.00										
TOTAL		6	407	420	111	31	25												
CUM. TOTAL	1000	1000	994	589	167	50	25												
COL. AVG.	0.00	14.50	12.89	11.50	7.78	3.90	4.25												

AVERAGE SIG. HEIGHT = 3.28 FT
 VARIANCE OF SIG. HEIGHT = .75 FT SQ
 STANDARD DEVIATION OF HEIGHT = .86 FT
 AVERAGE WAVE PERIOD = 11.09 SECS
 VARIANCE OF WAVE PERIOD = 25.12 SEC SQ
 STANDARD DEVIATION OF PERIOD = 5.01 SECS

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME,
 * CALMS ARE OMITTED.

86 OBSERVATIONS

SUMMARY FOR SEP 73

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.*	CUM.*	ROW
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9								1000	0.00
3.0 = 3.9			23	47	93	47	209	1000	4.28
4.0 = 4.9				12			12	791	3.50
5.0 = 5.9								779	0.00
6.0 = 6.9					12	12	23	779	5.00
7.0 = 7.9								756	0.00
8.0 = 8.9			23	12			35	756	2.83
9.0 = 9.9								721	0.00
10.0 = 10.9			23		12		35	721	3.17
11.0 = 11.9								686	0.00
12.0 = 12.9			23	12			35	686	2.83
13.0 = 13.9								651	0.00
14.0 = 14.9			174	70	12		256	651	2.86
15.0 = 15.9								395	0.00
16.0 = 16.9			140	174	81		395	395	3.35
TOTAL			407	326	209	58			3.42
CUM. TOTAL	1000	1000	1000	593	267	58			
COL. AVG.	0.00*	0.00	13.87	13.36	9.72	4.10	12.27		

AVERAGE SIG. HEIGHT = 3.38 FT

AVERAGE WAVE PERIOD = 12.13 SEC*

VARIANCE OF SIG. HEIGHT = .75 FT SQ

VARIANCE OF WAVE PERIOD = 28.32 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .87 FT

STANDARD DEVIATION OF PERIOD = 5.32 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights
 are up to 20% too high and wave periods tend to be too short.

155 OBSERVATIONS

SUMMARY FOR OCT 73 OCT 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOT.*	CUM.*	ROW
0.0 = .9											1000	0.00
1.0 = 1.9											1000	0.00
2.0 = 2.9											1000	0.00
3.0 = 3.9		6	103	84	26	19				239	1000	3.28
4.0 = 4.9				6						6	761	3.50
5.0 = 5.9				19	13					32	755	3.90
6.0 = 6.9				13	6	13	6		6	49	723	5.36
7.0 = 7.9											677	0.00
8.0 = 8.9											677	0.00
9.0 = 9.9											677	0.00
10.0 = 10.9			19	6						26	677	2.75
11.0 = 11.9											652	0.00
12.0 = 12.9			52	6						58	652	2.61
13.0 = 13.9											594	0.00
14.0 = 14.9		32	103	84	13	6	6			245	594	3.00
15.0 = 15.9											348	0.00
16.0 = 16.9			148	142	13	13				316	348	3.15
17.0 = 17.9											32	0.00
18.0 = 18.9											32	0.00
19.0 = 19.9											32	0.00
20.0 = 20.9			19		6	6				32	32	3.50
21.0 =											0.00	
TOTAL		39	445	361	77	58	13		6			3.24
CUM. TOTAL	1000	1000	961	516	155	77	19	6	6			
COL. AVG.	0.00*	12.67	12.47	11.68	9.50	10.17	10.30	0.00	6.50	11.76		

AVERAGE SIG. HEIGHT = 3.25 FT

AVERAGE WAVE PERIOD = 11.61 SEC*

VARIANCE OF SIG. HEIGHT = 1.00 FT SQ

VARIANCE OF WAVE PERIOD = 32.10 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.00 FT

STANDARD DEVIATION OF PERIOD = 5.67 SEC*

BEST AVAILABLE COPY

205 OBSERVATIONS

SUMMARY FOR NOV 73 NOV 74

PERIOD
(SECS)

BIG, HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.	CUM. NO.	NO.
0.0 - 1.0										1000	0.00
1.0 - 2.0										1000	0.00
2.0 - 3.0										1000	0.00
3.0 - 4.0			9	117	73	20	10			224	1000 3.11
4.0 - 5.0				15	20	10				44	776 3.34
5.0 - 6.0				10	29	34	5			70	732 3.44
6.0 - 7.0				10	10	10	10	5	10	54	654 4.06
7.0 - 8.0				5	24					29	600 3.53
8.0 - 9.0				24	15	10				49	571 3.20
9.0 - 10.0											522 0.00
10.0 - 11.0				10	5					15	522 2.83
11.0 - 12.0											507 0.00
12.0 - 13.0			5	44	5	5				59	507 2.67
13.0 - 14.0											449 0.00
14.0 - 15.0				127	48	34	10			268	449 3.23
15.0 - 16.0											180 0.00
16.0 - 17.0				54	78	20	5		5	161	180 3.47
17.0 - 18.0											20 0.00
18.0 - 19.0											20 0.00
19.0 - 20.0											20 0.00
20.0 - 21.0											20 0.00
21.0 -											0.00
TOTAL		10	415	366	151	39	5	15			3.37
CUM. TOTAL	1000	1000	490	576	210	59	20	15			
COL. AVG.	0.00	8.00	10.14	10.63	10.08	8.88	6.50	9.83	10.23		

AVERAGE BIG, HEIGHT = 3.30 FT VARIANCE OF BIG, HEIGHT = 1.01 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.00 FT
AVERAGE WAVE PERIOD = 10.03 SECS VARIANCE OF WAVE PERIOD = 28.69 SEC SQ
STANDARD DEVIATION OF PERIOD = 5.36 SECS

RESULTS OBTAINED FROM 1024-RECORD DIGITAL RECORDER TAKEN WITH A PRESSURE (NO. 3)
WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEP.
CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

84 OBSERVATIONS

SUMMARY FOR DEC 74

PERIOD
(SECS)

BIG, HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	TOT.	CUM. NO.	NO.
0.0 - 1.0													1000	0.00
1.0 - 2.0													1000	0.00
2.0 - 3.0													1000	0.00
3.0 - 4.0			12	34	12	12							71	1000 2.83
4.0 - 5.0					12								24	929 0.00
5.0 - 6.0					12	12	12						36	929 5.00
6.0 - 7.0					12	12	12	24					60	905 4.90
7.0 - 8.0					12	12	12						48	869 5.30
8.0 - 9.0					12	12							48	810 3.75
9.0 - 10.0					12	12							12	762 3.50
10.0 - 11.0													24	750 3.00
11.0 - 12.0														726 0.00
12.0 - 13.0														726 2.90
13.0 - 14.0														667 0.00
14.0 - 15.0														667 3.93
15.0 - 16.0														595 0.00
16.0 - 17.0														357 3.63
17.0 - 18.0														36 0.00
18.0 - 19.0														36 0.00
19.0 - 20.0														36 0.00
20.0 - 21.0														36 3.17
21.0 -														0.00
TOTAL		48	286	310	214	48	60		12	12	12			3.82
CUM. TOTAL	1000	1000	492	467	557	483	95	36	36	24	12			
COL. AVG.	0.00	11.25	13.63	14.04	13.50	9.75	9.90	0.00	14.50	6.50	16.50	13.17		

AVERAGE BIG, HEIGHT = 3.83 FT VARIANCE OF BIG, HEIGHT = 2.30 FT SQ
STANDARD DEVIATION OF HEIGHT = 1.52 FT
AVERAGE WAVE PERIOD = 13.66 SECS VARIANCE OF WAVE PERIOD = 20.14 SEC SQ
STANDARD DEVIATION OF PERIOD = 4.49 SECS

1760 OBSERVATIONS

SUMMARY FOR 21 months Feb 73 Through Dec 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9													1000	0.00
1.0 - 1.9													1000	0.00
2.0 - 2.9													1000	0.00
3.0 - 3.9		7	87	57	25	10	4	2				193	1000	3.30
4.0 - 4.9		1	3	12	5	2						24	807	3.71
5.0 - 5.9			7	19	21	5	7	1		1		60	784	4.35
6.0 - 6.9			4	7	12	8	5	5	1	1		43	723	5.11
7.0 - 7.9			4	10	4	2	3	1				24	680	4.22
8.0 - 8.9			11	9	6	2	1	1		1		30	656	3.75
9.0 - 9.9			4	3	1	1	1	1				10	626	3.72
10.0 - 10.9	1	10	6	1								18	616	2.92
11.0 - 11.9													598	0.00
12.0 - 12.9		8	51	22	5		1					85	598	2.79
13.0 - 13.9													513	0.00
14.0 - 14.9		11	132	92	27	5	2		1			270	513	3.10
15.0 - 15.9													243	0.00
16.0 - 16.9		1	96	91	31	4		1			1	224	243	3.27
17.0 - 17.9													19	0.00
18.0 - 18.9													19	0.00
19.0 - 19.9													19	0.00
20.0 - 20.9			9	7	3	1						19	19	3.24
21.0 +														0.00
TOTAL		28	419	335	141	39	23	11	2	2	1			3.38
CUM. TOTAL	1000	1000	972	553	218	77	38	15	4	2	1			
COL. AVG.	0.00	10.84	11.87	11.63	10.14	7.84	6.91	6.82	9.17	6.83	16.50	11.18		

AVERAGE SIG. HEIGHT = 3.35 FT

AVERAGE WAVE PERIOD = 11.01 SEC*

VARIANCE OF SIG. HEIGHT = 1.25 FT SQ

VARIANCE OF WAVE PERIOD = 27.85 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.12 FT

STANDARD DEVIATION OF PERIOD = 5.28 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 3)

WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

NOTE: Results may have been overcompensated such that significant heights are up to 20 percent too high and wave periods tend to be too short.

Table A-59. CERC wave gage history for Pt. Mugu, California (Gage No. 4).

CERC Form 174-74 18 Mar 74		LOCATION: Three miles southeast of Port Hueneme, Pt. Mugu, California (Gage No. 4)					
COORDINATES: 34°07' N., 119°09' W.							
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Pier Length (feet)
Pressure	27 Mar. 1970		Still operative as of 1 Jan. 1975	---	-11 to +19 (mounted 29 ft below MSL)	31	---
						1,300 feet from shore	

Table A-60. Number of analyzed records from Pt. Mugu, California
(Gage No. 4).¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1973			37	62	92	91	67	86	86	78	107	53	759
1974	101	100	94	70	99	96	82	78	49	55	99	92	1015

¹From 1,024-second records taken four times daily. Results from records taken before January 1973 have not been compensated for hydrodynamic attenuation due to submergence of the gage. Results taken during January 1973 to December 1974 may have been overcompensated such that significant heights are up to 20 percent too high and wave periods tend to be too short.

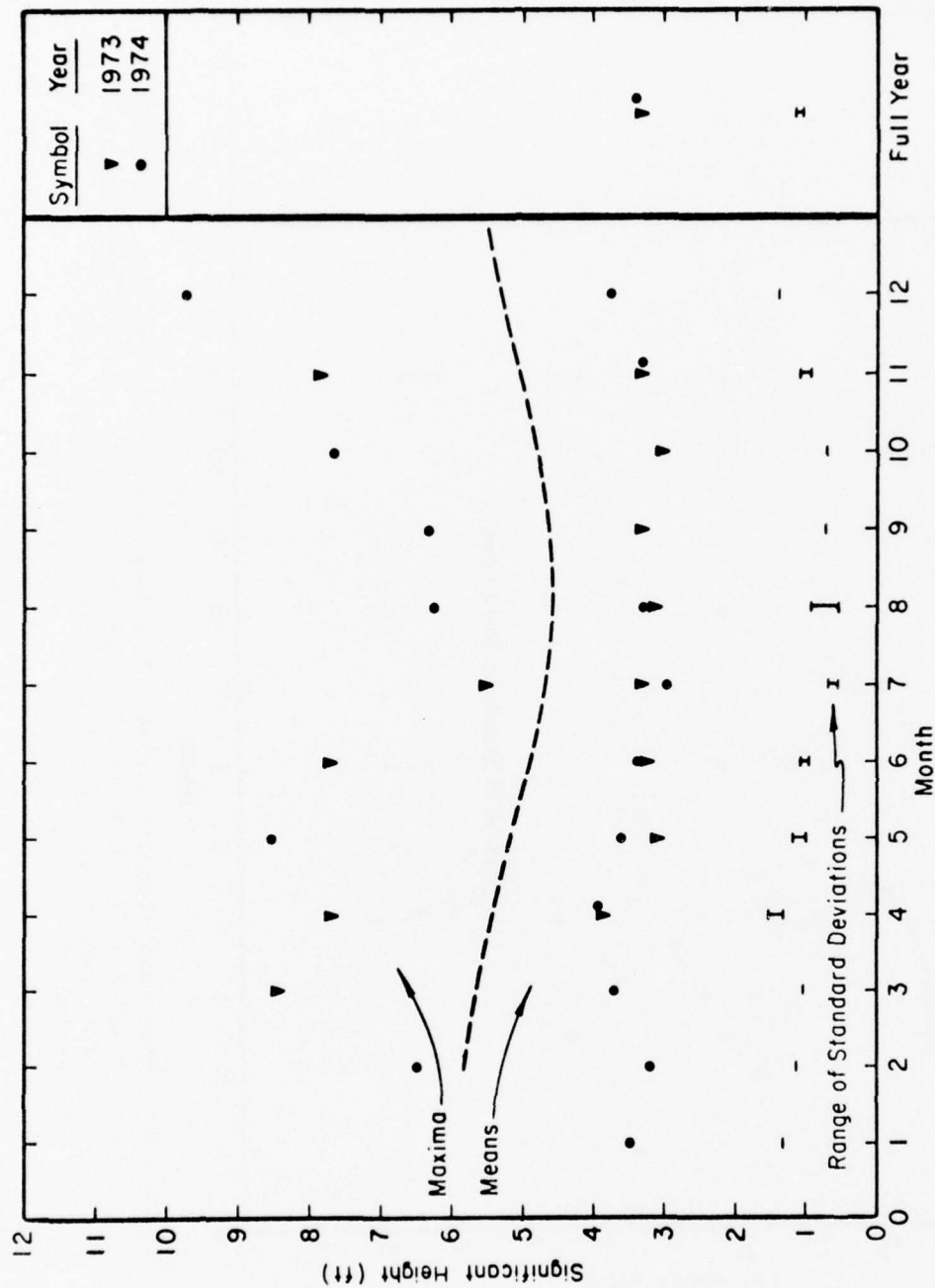


Figure A-93. Maxima, means, and standard deviations of significant height from Pt. Mugu, California (Gage No. 4). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that significant heights are up to 20 percent too high.

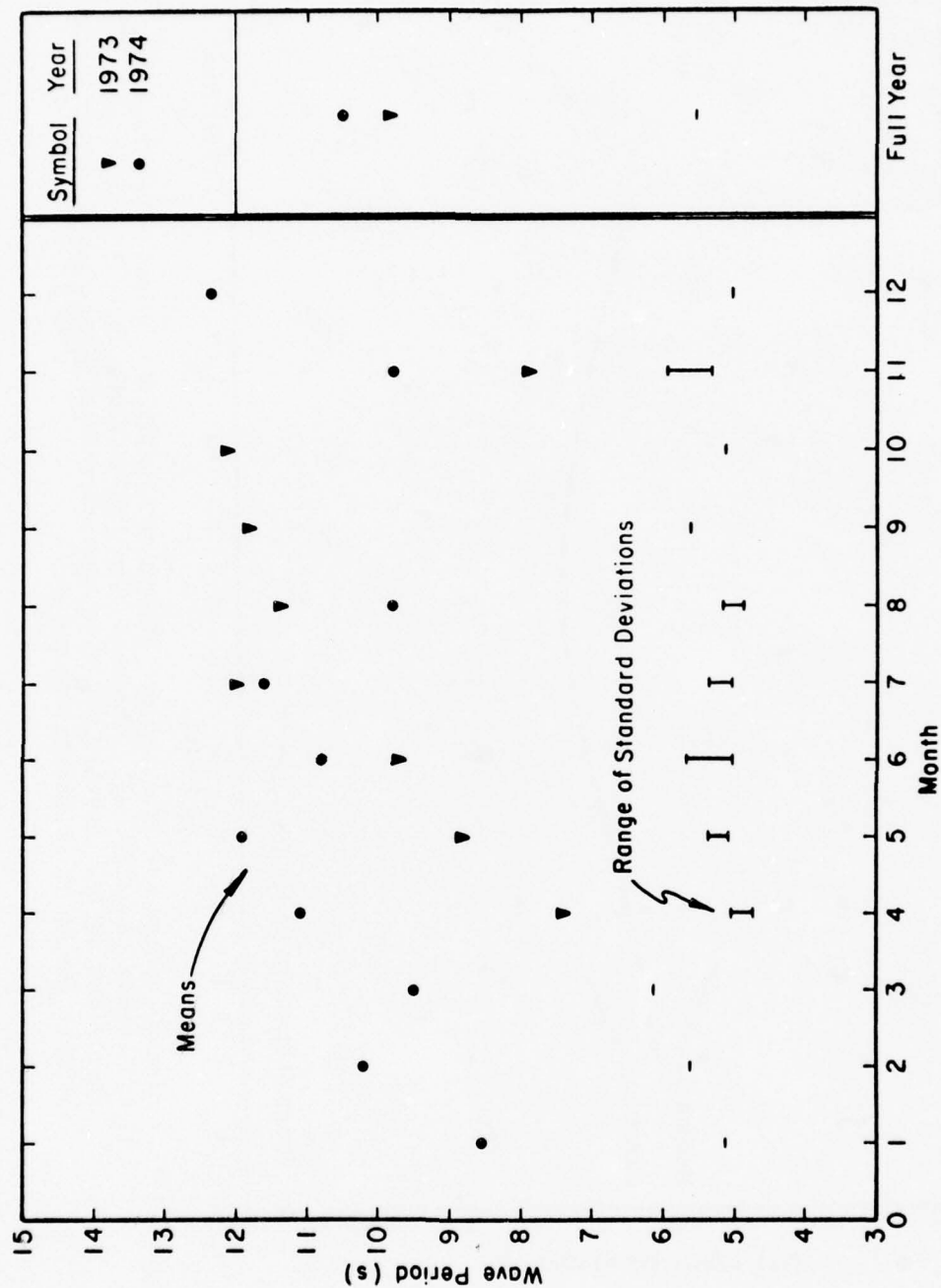
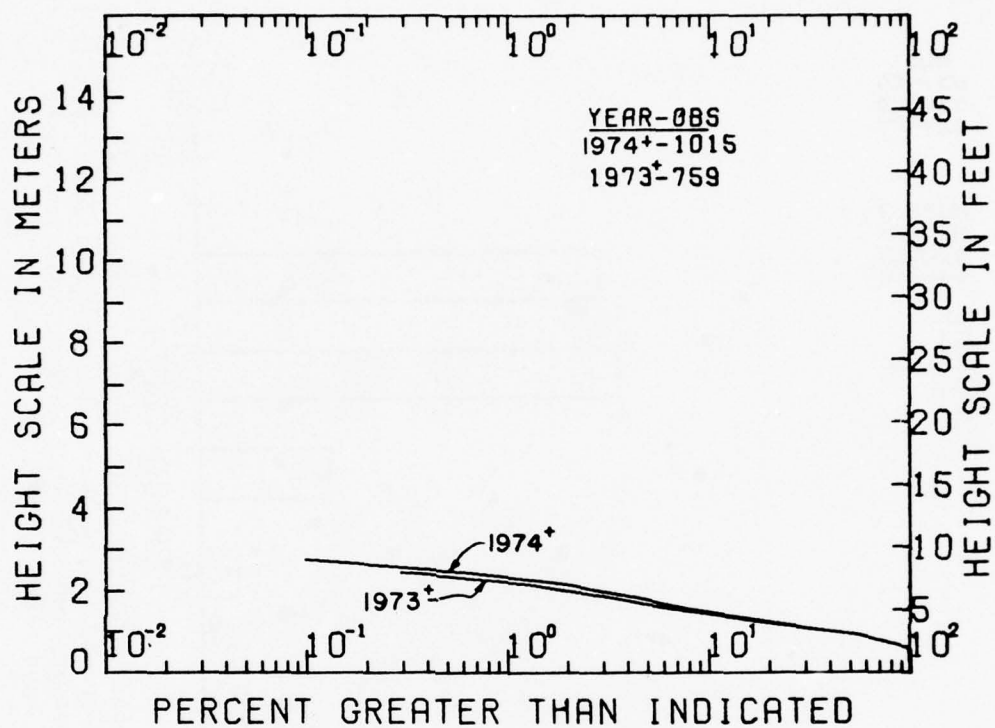


Figure A-94. Means and standard deviations of wave periods for Pt. Mugu, California (Gage No. 4). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that wave periods tend to be too short.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily; results may have been overcompensated such that significant heights are up to 20 percent too high.

Figure A-95. Annual cumulative significant height distributions from Pt. Mugu, California (Gage No. 4).

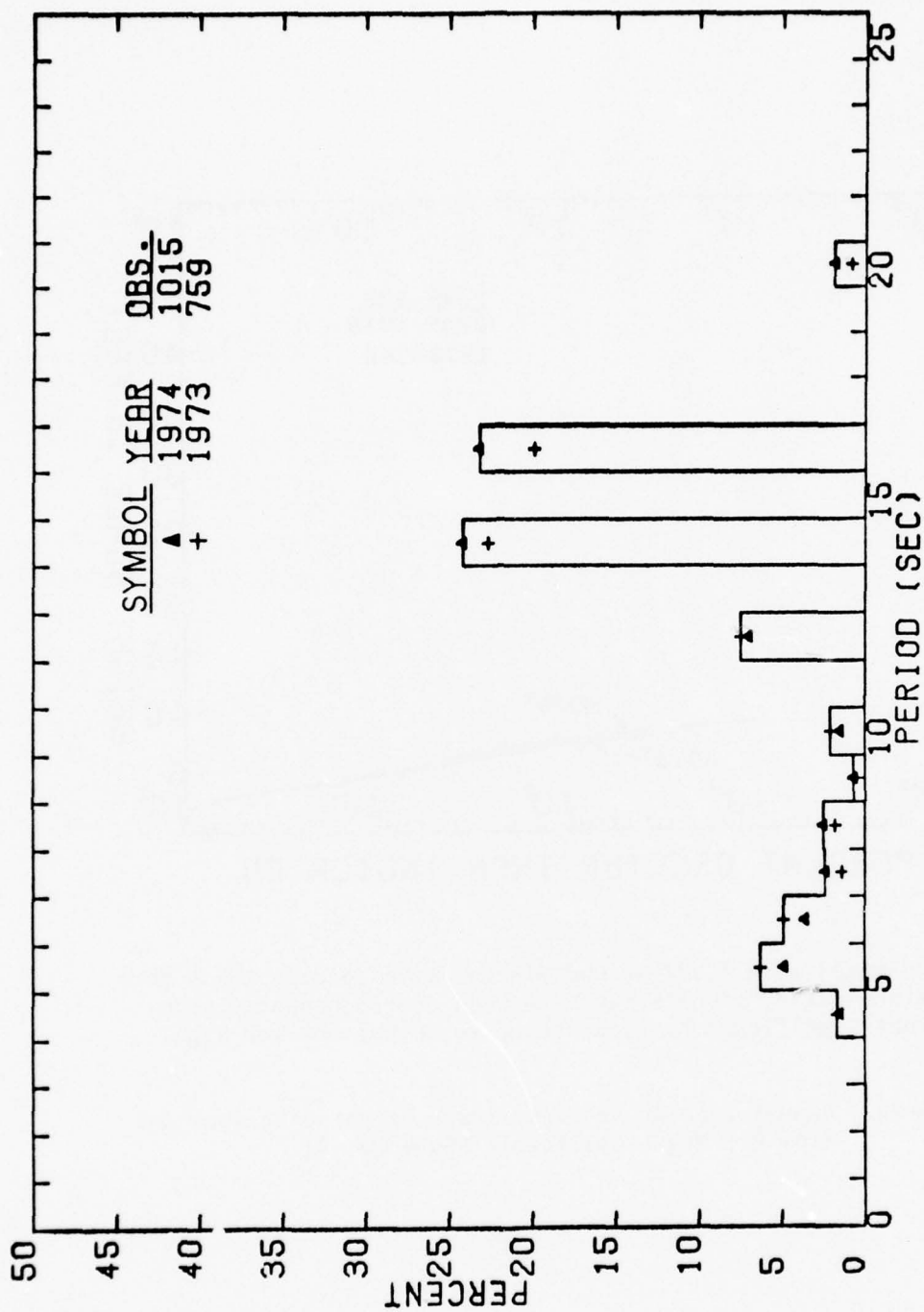


Figure A-96. Annual significant period distributions from Pt. Mugu, California (Gage No. 4).
Computed from 1,024-second digital wave records taken four times daily. Results
may have been overcompensated such that wave periods tend to be too short; periods
less than 4 seconds have been omitted.

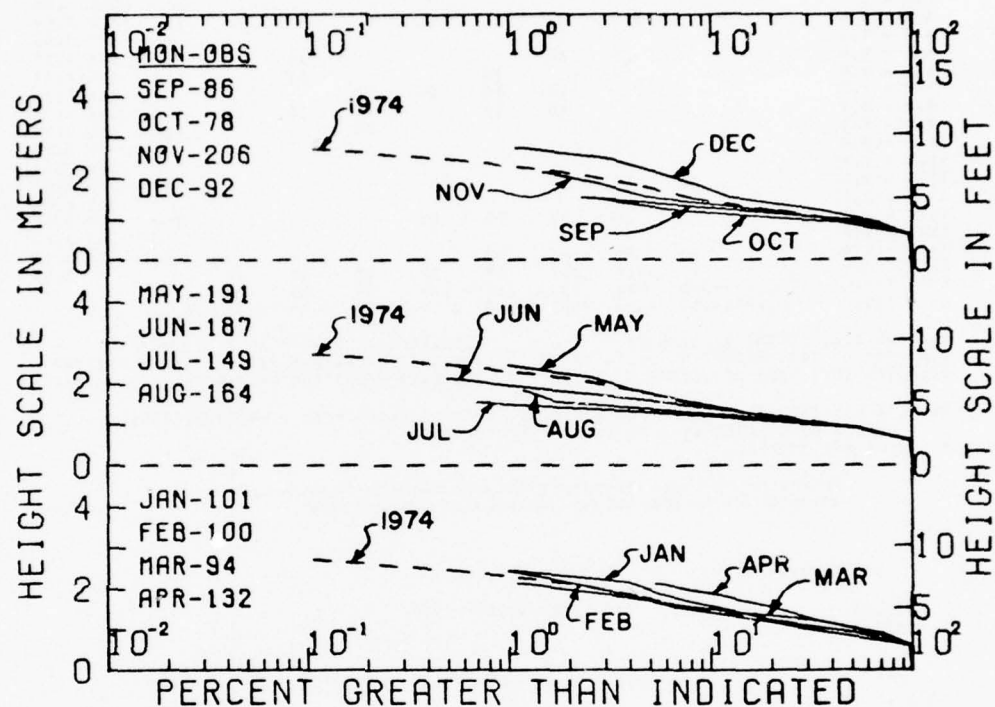


Figure A-97. Seasonal summaries of cumulative significant height distributions from Pt. Mugu, California (Gage No. 4). Computed from 1,024-second digital wave records taken four times daily. Results may have been overcompensated such that significant heights are up to 20 percent too high.

Table A-61. Wave climate for Pt. Mugu, California.
Distribution of significant height versus period
(in observations per 1,000 observations).

101 OBSERVATIONS										
SUMMARY FOR JAN 74										
PERIOD (SECS)	SIG. HEIGHT (FT)									
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOT.*
0.0 = .9										CUM. ROW
1.0 = 1.9										TOT.* AVG.*
2.0 = 2.9										1000 0.00
3.0 = 3.9			267	99		10				1000 0.00
4.0 = 4.9				10						1000 0.00
5.0 = 5.9			10	20						1000 0.00
6.0 = 6.9			10		10			10		1000 0.00
7.0 = 7.9				10	10	20	10			1000 0.00
8.0 = 8.9				40	10			10	10	1000 0.00
9.0 = 9.9							10			1000 0.00
10.0 = 10.9			10							1000 0.00
11.0 = 11.9										1000 0.00
12.0 = 12.9		10	40	50						1000 0.00
13.0 = 13.9										1000 0.00
14.0 = 14.9		10	40	79	59	20				1000 0.00
15.0 = 15.9										1000 0.00
16.0 = 16.9										1000 0.00
TOTAL	1000	1000	30	416	347	99	50	20	30	10
CUM. TOTAL	0.00	14.50	6.93	9.61	12.60	9.50	8.50	6.83	6.50	6.82
COL. AVG.										

AVERAGE SIG. HEIGHT = 3.45 FT AVERAGE WAVE PERIOD = 8.56 SEC
VARIANCE OF SIG. HEIGHT = 1.72 FT SQ VARIANCE OF WAVE PERIOD = 26.40 SEC SQ
STANDARD DEVIATION OF HEIGHT = 1.31 FT STANDARD DEVIATION OF PERIOD = 5.14 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)
WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights
are up to 20% too high and wave periods tend to be too short.

99 OBSERVATIONS										
SUMMARY FOR FEB 74										
PERIOD (SECS)	SIG. HEIGHT (FT)									
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.*	CUM. ROW	TOT.* AVG.*
0.0 = .9									1000	0.00
1.0 = 1.9									1000	0.00
2.0 = 2.9									1000	0.00
3.0 = 3.9			212	71	10	10	10	313	1000	3.02
4.0 = 4.9					10			10	687	4.50
5.0 = 5.9				20	10		10	40	677	4.50
6.0 = 6.9				10			10	20	636	5.00
7.0 = 7.9									616	0.00
8.0 = 8.9					20	10		30	616	4.83
9.0 = 9.9									586	0.00
10.0 = 10.9									586	0.00
11.0 = 11.9									586	0.00
12.0 = 12.9			51	10				61	586	2.67
13.0 = 13.9									525	0.00
14.0 = 14.9			212	51	51			313	525	2.98
15.0 = 15.9									212	0.00
16.0 = 16.9									212	3.02
TOTAL			131	61	10	10	30	212	212	3.16
CUM. TOTAL	1000	1000	1000	394	172	61	30			
COL. AVG.	0.00	0.00	10.92	10.27	10.86	9.50	5.17	10.55		

AVERAGE SIG. HEIGHT = 3.13 FT AVERAGE WAVE PERIOD = 10.32 SEC
VARIANCE OF SIG. HEIGHT = .98 FT SQ VARIANCE OF WAVE PERIOD = 31.37 SEC SQ
STANDARD DEVIATION OF HEIGHT = .99 FT STANDARD DEVIATION OF PERIOD = 5.60 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)
WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

94 OBSERVATIONS

SUMMARY FOR MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.	CUM. TOT.	ROW. AVG.
0.0 = .9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9										1000	0.00
3.0 = 3.9			96	223	93	32	11		815	1000	3.63
4.0 = 4.9				11	21	11			43	565	0.00
5.0 = 5.9								11	11	565	7.50
6.0 = 6.9			11	11	11				32	552	3.50
7.0 = 7.9					11				11	500	4.50
8.0 = 8.9						11			11	489	5.50
9.0 = 9.9										479	0.00
10.0 = 10.9										479	0.00
11.0 = 11.9				21	11		11		43	436	0.00
12.0 = 12.9										436	0.00
13.0 = 13.9										436	0.00
14.0 = 14.9			74	43	74				191	436	3.50
15.0 = 15.9										249	0.00
16.0 = 16.9			64	64	74				202	249	3.55
17.0 = 17.9										43	0.00
18.0 = 18.9										43	0.00
19.0 = 19.9										43	0.00
20.0 = 20.9			32	11					43	43	2.75
21.0 +										0.00	
TOTAL			277	383	255	53	21	11			3.69
CUM. TOTAL	1000	1000	1000	723	340	85	32	11			
COL. AVG.	0.00	0.00	11.58	8.03	11.82	5.10	8.00	6.50	9.76		

AVERAGE SIG. HEIGHT = 3.68 FT AVERAGE WAVE PERIOD = 9.87 SEC
 VARIANCE OF SIG. HEIGHT = 1.04 FT SQ VARIANCE OF WAVE PERIOD = 57.65 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.02 FT STANDARD DEVIATION OF PERIOD = 6.16 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights
 are up to 20% too high and wave periods tend to be too short.

132 OBSERVATIONS

SUMMARY FOR APR 73 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.	CUM. TOT.	ROW. AVG.
0.0 = .9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9										1000	0.00
3.0 = 3.9			144	61	15				220	1000	2.91
4.0 = 4.9				15	8		8		30	780	4.50
5.0 = 5.9				23	45	23	8	23	121	750	5.19
6.0 = 6.9				8	30	38	30	23	129	629	5.74
7.0 = 7.9				8		23	8	8	45	500	5.67
8.0 = 8.9				8		8			15	455	4.50
9.0 = 9.9										439	0.00
10.0 = 10.9			8						8	439	2.50
11.0 = 11.9										432	0.00
12.0 = 12.9			15	30	8				53	432	3.36
13.0 = 13.9										379	0.00
14.0 = 14.9			106	68	15		8		197	379	3.15
15.0 = 15.9										182	0.00
16.0 = 16.9			76	76	23				174	182	3.20
17.0 = 17.9										8	0.00
18.0 = 18.9										8	0.00
19.0 = 19.9										8	0.00
20.0 = 20.9				8					8	8	3.50
21.0 +										0.00	
TOTAL			348	303	144	91	61	53			3.87
CUM. TOTAL	1000	1000	1000	652	348	205	114	53			
COL. AVG.	0.00	0.00	10.22	11.05	6.90	6.67	7.25	6.21	9.51		

AVERAGE SIG. HEIGHT = 3.87 FT AVERAGE WAVE PERIOD = 9.36 SEC
 VARIANCE OF SIG. HEIGHT = 1.93 FT SQ VARIANCE OF WAVE PERIOD = 27.50 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.39 FT STANDARD DEVIATION OF PERIOD = 5.24 SEC

191 OBSERVATIONS

SUMMARY FOR MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9											1000	0.00
1.0 = 1.9											1000	0.00
2.0 = 2.9											1000	0.00
3.0 = 3.9		5	147	79	5					236	1000	2.86
4.0 = 4.9			5	10						16	764	3.17
5.0 = 5.9			5	31	21	10	5		5	79	749	4.50
6.0 = 6.9			10	10	5	21	10	5	5	68	670	5.19
7.0 = 7.9			5					10		16	602	5.83
8.0 = 8.9				16	5					21	586	3.75
9.0 = 9.9					5					5	565	4.50
10.0 = 10.9			10							10	560	2.50
11.0 = 11.9											590	0.00
12.0 = 12.9		5	63	16						84	550	2.63
13.0 = 13.9											466	0.00
14.0 = 14.9		5	94	99	26	5				230	466	3.20
15.0 = 15.9											236	0.00
16.0 = 16.9		5	105	79	21	5				215	236	3.11
17.0 = 17.9											21	0.00
18.0 = 18.9											21	0.00
19.0 = 19.9											21	0.00
20.0 = 20.9				16	5					21	21	3.75
21.0 =												0.00
TOTAL		21	445	356	94	42	16	16	10			3.39
CUM. TOTAL	1000	1000	979	534	178	84	42	24	10			
COL. AVG.	0.00	11.75	10.46	11.10	11.61	8.50	6.17	7.17	6.00	10.58		

AVERAGE SIG. HEIGHT = 3.33 FT

AVERAGE WAVE PERIOD = 10.42 SEC

VARIANCE OF SIG. HEIGHT = 1.26 FT SQ

VARIANCE OF WAVE PERIOD = 30.06 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.12 FT

STANDARD DEVIATION OF PERIOD = 5.48 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)

WAVE GAGE LOCATED AT 3 MI SE OF PORT MUENEME.

• CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

187 OBSERVATIONS

SUMMARY FOR JUN 73 JUN 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 = .9										1000	0.00
1.0 = 1.9										1000	0.00
2.0 = 2.9										1000	0.00
3.0 = 3.9			128	112	21	27	5		294	1000	3.37
4.0 = 4.9				5					5	706	3.50
5.0 = 5.9			5	11	16				32	701	3.83
6.0 = 6.9			11	11	11	11			43	668	4.00
7.0 = 7.9			5				5	5	16	626	5.50
8.0 = 8.9			5		5				11	610	3.90
9.0 = 9.9				5					5	599	3.50
10.0 = 10.9			5	16					21	594	3.25
11.0 = 11.9										572	0.00
12.0 = 12.9			59	37	21				118	572	3.18
13.0 = 13.9										455	0.00
14.0 = 14.9			155	70	27				251	455	2.99
15.0 = 15.9										203	0.00
16.0 = 16.9			86	86	27	5			203	203	3.26
TOTAL			480	353	128	43	11	5			3.31
CUM. TOTAL	1000	1000	1000	540	187	59	16	5			
COL. AVG.	0.00	0.00	11.06	10.35	10.71	5.88	5.90	7.90	10.46		

AVERAGE SIG. HEIGHT = 3.28 FT

AVERAGE WAVE PERIOD = 10.29 SEC

VARIANCE OF SIG. HEIGHT = .97 FT SQ

VARIANCE OF WAVE PERIOD = 20.36 SEC SQ

STANDARD DEVIATION OF HEIGHT = .98 FT

STANDARD DEVIATION OF PERIOD = 5.42 SEC

BEST AVAILABLE COPY

149 OBSERVATIONS

SUMMARY FOR JUL 73 JUL 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9								1000	0.00
3.0 - 3.9			128	47	7		181	1000	2.83
4.0 - 4.9			7	7			13	819	3.00
5.0 - 5.9				27	20		47	805	3.93
6.0 - 6.9			7	7	7	7	27	758	4.00
7.0 - 7.9								732	0.00
8.0 - 8.9			11	7			20	732	2.83
9.0 - 9.9			20				20	711	2.50
10.0 - 10.9			13				13	691	2.50
11.0 - 11.9								678	0.00
12.0 - 12.9			87	20			107	678	2.69
13.0 - 13.9								570	0.00
14.0 - 14.9			114	161			275	570	3.00
15.0 - 15.9								205	0.00
16.0 - 16.9			67	154	47		268	205	3.43
17.0 - 17.9								27	0.00
18.0 - 18.9								27	0.00
19.0 - 19.9								27	0.00
20.0 - 20.9			13	13			27	27	3.00
21.0 -									0.00
TOTAL			470	443	81	7			3.12
CUM. TOTAL	1000	1000	1000	530	87	7			
COL. AVG.	0.00	0.00	10.64	13.21	11.63	6.50	11.98		

AVERAGE SIG. HEIGHT = 3.09 FT AVERAGE WAVE PERIOD = 11.79 SEC
 VARIANCE OF SIG. HEIGHT = .39 FT SQ VARIANCE OF WAVE PERIOD = 27.86 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .63 FT STANDARD DEVIATION OF PERIOD = 5.28 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (W3, 4)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.
 0 CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights
 are up to 20% too high and wave periods tend to be too short.

164 OBSERVATIONS

SUMMARY FOR AUG 73 AUG 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9									1000	0.00
1.0 - 1.9									1000	0.00
2.0 - 2.9									1000	0.00
3.0 - 3.9			85	91	24	6	6	213	1000	3.36
4.0 - 4.9				18	6			24	787	3.75
5.0 - 5.9			6	30	24		6	67	762	4.05
6.0 - 6.9				12	12			24	695	4.00
7.0 - 7.9				18				18	671	3.50
8.0 - 8.9				12				12	652	3.50
9.0 - 9.9			12					12	640	2.50
10.0 - 10.9			18	24	6			49	628	3.25
11.0 - 11.9									579	0.00
12.0 - 12.9		6	67	30	12			116	579	2.92
13.0 - 13.9									463	0.00
14.0 - 14.9			177	110	6			293	463	2.92
15.0 - 15.9									171	0.00
16.0 - 16.9		6	55	79	18			159	171	3.19
17.0 - 17.9									12	0.00
18.0 - 18.9									12	0.00
19.0 - 19.9									12	0.00
20.0 - 20.9				12				12	12	3.50
21.0 -										0.00
TOTAL		12	421	439	110	6	12			3.21
CUM. TOTAL	1000	1000	988	567	128	18	12			
COL. AVG.	0.00	14.50	11.76	10.65	8.90	3.50	4.50	10.81		

AVERAGE SIG. HEIGHT = 3.19 FT AVERAGE WAVE PERIOD = 10.63 SEC
 VARIANCE OF SIG. HEIGHT = .56 FT SQ VARIANCE OF WAVE PERIOD = 26.13 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .75 FT STANDARD DEVIATION OF PERIOD = 5.11 SEC

86 OBSERVATIONS

SUMMARY FOR SEP 73

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM, TOT, *	ROW, AVG, *
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9								1000	0.00
3.0 = 3.9			81	128	47		256	1000	3.36
4.0 = 4.9								744	0.00
5.0 = 5.9						12	12	744	5.50
6.0 = 6.9						12	12	733	5.50
7.0 = 7.9								721	0.00
8.0 = 8.9				12	12		23	721	4.00
9.0 = 9.9								698	0.00
10.0 = 10.9			12		12		23	698	3.50
11.0 = 11.9								674	0.00
12.0 = 12.9			23				23	674	2.50
13.0 = 13.9								651	0.00
14.0 = 14.9			140	140			279	651	3.00
15.0 = 15.9								372	0.00
16.0 = 16.9			105	221	35		360	372	3.31
17.0 = 17.9								12	0.00
18.0 = 18.9								12	0.00
19.0 = 19.9								12	0.00
20.0 = 20.9				12			12	12	3.50
21.0 +									0.00
TOTAL			360	512	105	23			3.29
CUM, TOTAL	1000	1000	1000	640	128	23			
COL, AVG,	0.00*	0.00	12.34	12.61	9.17	6.00	12.00		

AVERAGE SIG, HEIGHT = 3.29 FT

AVERAGE WAVE PERIOD = 11.83 SEC*

VARIANCE OF SIG, HEIGHT = .47 FT SQ

VARIANCE OF WAVE PERIOD = 31.43 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .68 FT

STANDARD DEVIATION OF PERIOD = 5.61 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)

WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

78 OBSERVATIONS

SUMMARY FOR OCT 73

PERIOD
(SECS)

SIG, HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT, *	CUM, TOT, *	ROW, AVG, *
0.0 = .9								1000	0.00
1.0 = 1.9								1000	0.00
2.0 = 2.9								1000	0.00
3.0 = 3.9			154	26			179	1000	2.64
4.0 = 4.9				13			13	821	3.50
5.0 = 5.9				13	26		38	808	4.17
6.0 = 6.9					13	26	38	769	5.17
7.0 = 7.9								731	0.00
8.0 = 8.9								731	0.00
9.0 = 9.9								731	0.00
10.0 = 10.9								731	0.00
11.0 = 11.9								731	0.00
12.0 = 12.9			38	13			51	731	2.75
13.0 = 13.9								679	0.00
14.0 = 14.9		13	192	128			333	679	2.85
15.0 = 15.9								346	0.00
16.0 = 16.9			167	179			346	346	3.02
TOTAL		13	551	372	38	26			3.01
CUM, TOTAL	1000	1000	987	436	64	26			
COL, AVG,	0.00*	14.50	11.90	13.98	5.83	6.50	12.33		

AVERAGE SIG, HEIGHT = 2.98 FT

AVERAGE WAVE PERIOD = 12.18 SEC*

VARIANCE OF SIG, HEIGHT = .47 FT SQ

VARIANCE OF WAVE PERIOD = 26.69 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .68 FT

STANDARD DEVIATION OF PERIOD = 5.17 SEC*

BEST AVAILABLE COPY

PERIOD (SECS)	SIG. HEIGHT (FT)										CUM. TOT. #	NO. AVG. #
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT. #	AVG. #
0.0 - .9											1000	0.00
1.0 - 1.9											1000	0.00
2.0 - 2.9											1000	0.00
3.0 - 3.9		5	214	136	19	10					360	1000 3.08
4.0 - 4.9				15	5		5				24	612 4.50
5.0 - 5.9				15	29	29					58	967 4.00
6.0 - 6.9				15	5	15	5	10			53	929 4.59
7.0 - 7.9				10	5						15	476 2.83
8.0 - 8.9				10	19	5					29	461 3.33
9.0 - 9.9					5						5	432 4.50
10.0 - 10.9				10	5						15	427 2.83
11.0 - 11.9												813 0.00
12.0 - 12.9		5	29								34	413 2.38
13.0 - 13.9												379 0.00
14.0 - 14.9				87	85	24					194	379 3.18
15.0 - 15.9												184 0.00
16.0 - 16.9				58	83	19	5				170	184 3.44
17.0 - 17.9												15 0.00
18.0 - 18.9												15 0.00
19.0 - 19.9												15 0.00
20.0 - 20.9					5	10					15	15 4.17
21.0 -												0.00
TOTAL		10	432	379	131	19	15	15				3.32
CUM. TOTAL	1000	1000	490	558	180	49	49	15				
COL. AVG.	0.00	8.00	6.58	9.51	9.94	7.50	5.83	8.83	9.03			

AVERAGE SIG. HEIGHT = 3.27 FT
 VARIANCE OF SIG. HEIGHT = .93 FT SQ
 STANDARD DEVIATION OF HEIGHT = .96 FT
 AVERAGE WAVE PERIOD = 8.81 SECS
 VARIANCE OF WAVE PERIOD = 32.87 SEC SQ
 STANDARD DEVIATION OF PERIOD = 5.76 SECS

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 8)
 WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.
 * CALMS ARE OMITTED.

Results may have been over-compensated such that significant heights are up to 20% too high and wave periods tend to be too short.

92 OBSERVATIONS		SUMMARY FOR DEC 74											
PERIOD (SECS)	SIG. HEIGHT (FT)										CUM. TOT. #	NO. AVG. #	
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT. #		
0.0 = .9												1000 0.00	
1.0 = 1.9												1000 0.00	
2.0 = 2.9												1000 0.00	
3.0 = 3.9		11	43	33	22	11	11				130	1000 3.58	
4.0 = 4.9												870 0.00	
5.0 = 5.9				11			11				22	870 5.00	
6.0 = 6.9					11	11					22	848 5.00	
7.0 = 7.9				22	11	22	11		11		76	826 5.38	
8.0 = 8.9			11	22	22						58	750 5.70	
9.0 = 9.9				11							11	696 5.50	
10.0 = 10.9		11	11	22							43	685 2.75	
11.0 = 11.9												641 0.00	
12.0 = 12.9				11	11						22	641 3.00	
13.0 = 13.9												620 0.00	
14.0 = 14.9		11	43	87	65		22		11		239	620 4.00	
15.0 = 15.9												380 0.00	
16.0 = 16.9			152	96	87					11	348	380 3.50	
17.0 = 17.9												33 0.00	
18.0 = 18.9												33 0.00	
19.0 = 19.9												33 0.00	
20.0 = 20.9				33							33	33 3.50	
21.0 =												0.00	
TOTAL		33	272	348	217	85	94		22	11		3.80	
CUM. TOTAL	1000	1000	967	696	348	130	87	55	55	11			
COL. AVG.	0.00	9.50	13.38	13.03	12.85	6.25	9.10	0.00	11.00	10.50	12.86		
AVERAGE SIG. HEIGHT = 3.76 FT													
VARIANCE OF SIG. HEIGHT = 1.95 FT SQ													
STANDARD DEVIATION OF HEIGHT = 1.40 FT													
AVERAGE WAVE PERIOD = 12.35 SECS													
VARIANCE OF WAVE PERIOD = 25.21 SEC SQ													
STANDARD DEVIATION OF PERIOD = 5.02 SECS													

1579 OBSERVATIONS

SUMMARY FOR 18 MONTHS APR 73 THROUGH DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT.*	CUM. TOT.*	RDW AVG.*
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9		2	144	94	18	9	3	1			270	1000	3.13
4.0 = 4.9			1	9	3		1				14	730	3.86
5.0 = 5.9			3	21	20	4	3	3	1		54	716	4.41
6.0 = 6.9			6	6	10	11	6	4	1		44	662	4.96
7.0 = 7.9			3	6	2	4	3	3	1		21	618	4.86
8.0 = 8.9			4	11	6	1		1	1		23	597	3.96
9.0 = 9.9			3	1	1	1	1				7	574	3.68
10.0 = 10.9	1	9	6	1							17	567	2.98
11.0 = 11.9												550	0.00
12.0 = 12.9	3	44	20	5			1				73	550	2.92
13.0 = 13.9												477	0.00
14.0 = 14.9	3	119	93	27	2	2			1		246	477	3.15
15.0 = 15.9												231	0.00
16.0 = 16.9	2	86	96	29	3		1			1	217	231	3.27
17.0 = 17.9												14	0.00
18.0 = 18.9												14	0.00
19.0 = 19.9												14	0.00
20.0 = 20.9			3	9	2						14	14	3.41
21.0 +													0.00
TOTAL		9	426	372	123	35	19	11	3	1			3.37
CUM. TOTAL	1000	1000	991	565	193	69	34	15	4	1			
COL. AVG.	0.00	11.90	10.59	11.04	10.60	7.03	6.93	7.00	8.50	16.50	10.53		

AVERAGE SIG. HEIGHT = 3.35 FT

AVERAGE WAVE PERIOD = 10.35 SEC*

VARIANCE OF SIG. HEIGHT = 1.10 FT SQ

VARIANCE OF WAVE PERIOD = 30.67 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.05 FT

STANDARD DEVIATION OF PERIOD = 5.54 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A PRESSURE (NO. 4)

WAVE GAGE LOCATED AT 3 MI SE OF PORT HUENEME.

* CALMS ARE OMITTED.

NOTE: Results may have been overcompensated such that significant heights are up to 20 percent too high and wave periods tend to be too short.

Table A-62. CERC wave gage history for Venice Fishing Pier, Venice, California.

CERC Form 174-74 18 Mar 74		LOCATION: Venice Fishing Pier, Venice, California					
COORDINATES: 33°59' N., 118°28' W.							
Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Pier Length (feet)
Step-resistance staff	12 Jan. 1966	23 Apr. 1968	Power turned off.	25	-11 to +14	20	1,200
	11 Oct. 1968	2 Apr. 1969	Switched completely to telemetering recorder at Los Angeles District Office.				

Table A-63. Number of analyzed pen and ink records from Venice, California.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
	1966	119	135	143	175	88	164	176	184	176	38	180	171

¹From 7-minute records taken six times daily and analyzed by the CERC method.

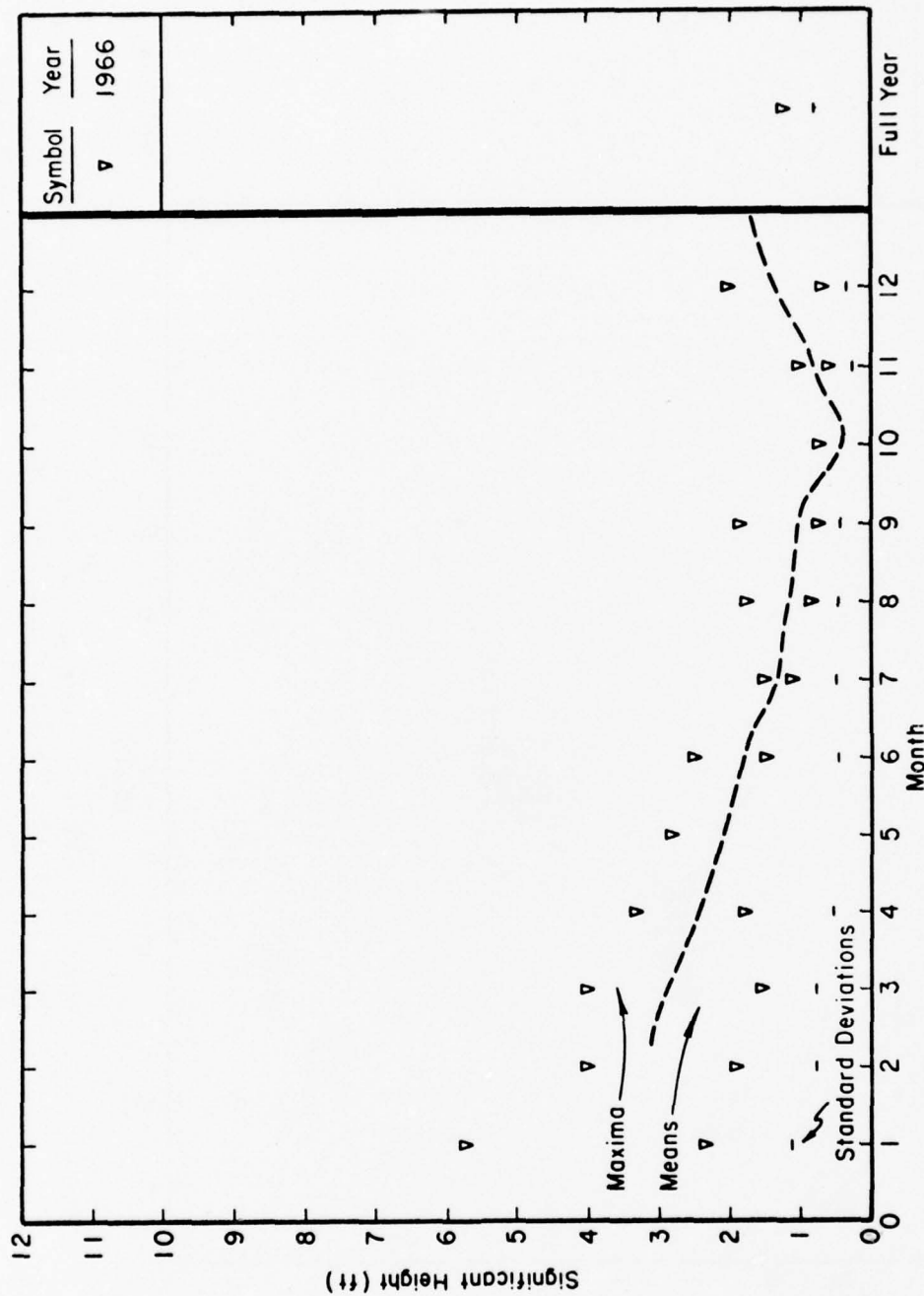


Figure A-98. Maxima, means, and standard deviations of significant height from Venice, California. Determined from 7-minute pen and ink records taken six times daily. Wave heights may be low due to old gage design and maintenance difficulties.

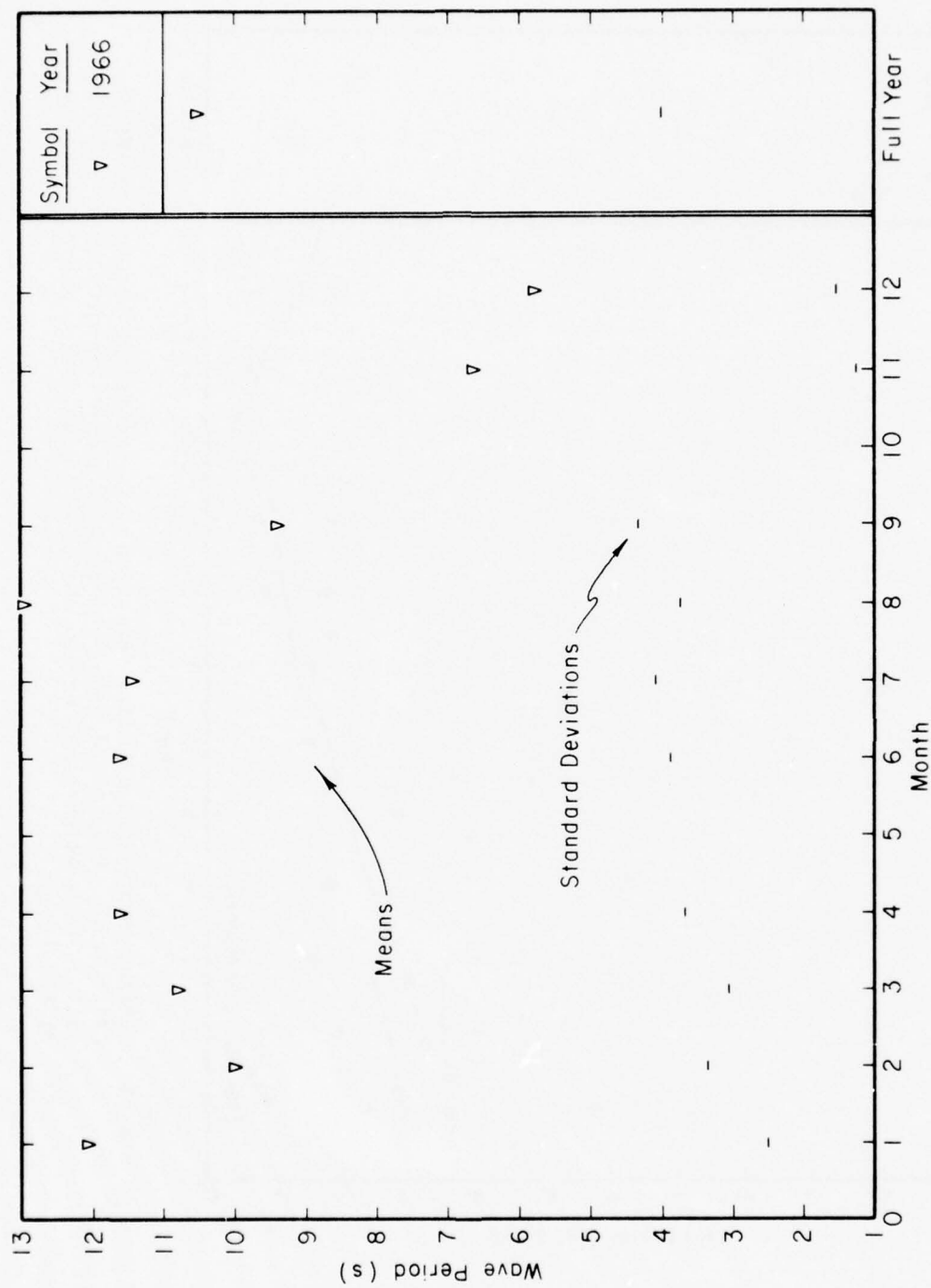


Figure A-99. Means and standard deviations of wave periods for Venice, California; determined from 7-minute pen and ink records taken six times daily.

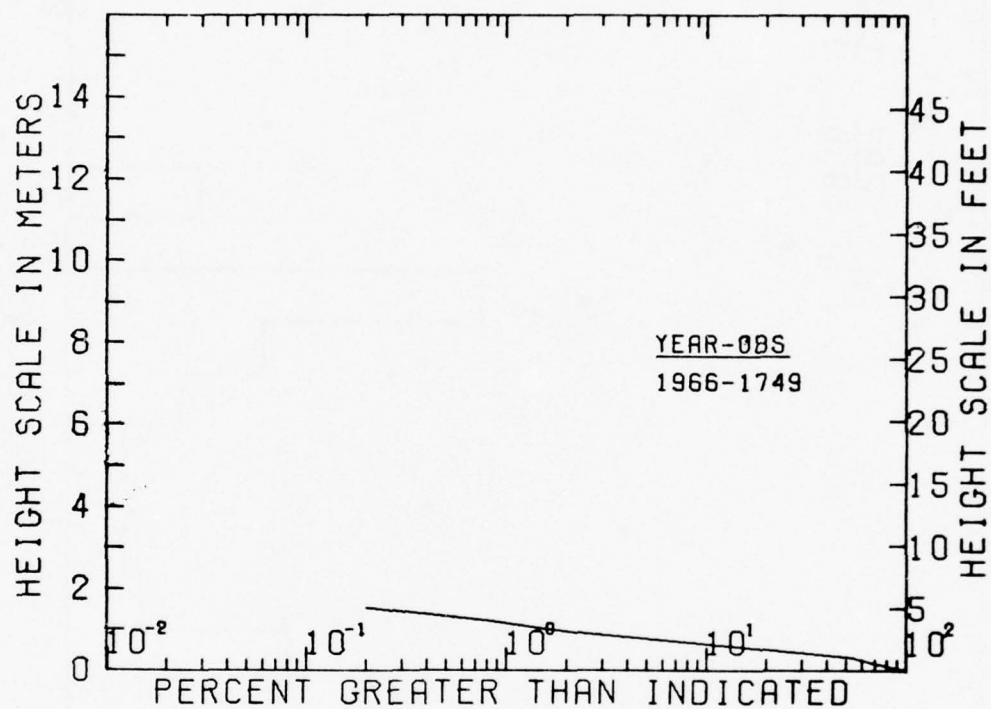


Figure A-100. Annual cumulative significant height distribution from Venice, California. Determined from 7-minute pen and ink records taken six times daily. Wave heights may be low due to old gage design and maintenance difficulties.

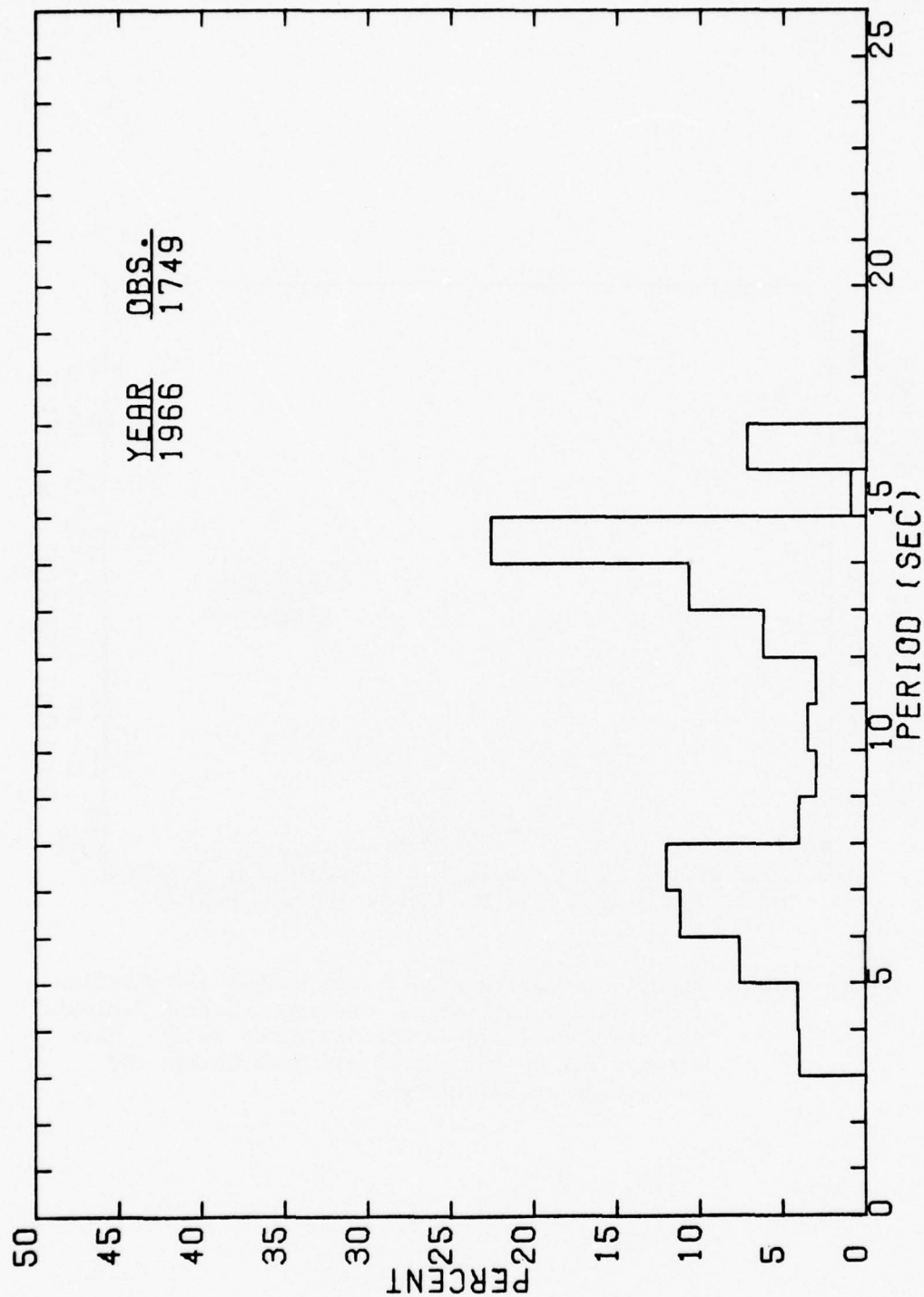


Figure A-101. Annual significant period distributions from Venice, California; determined from 7-minute pen and ink records taken six times daily.

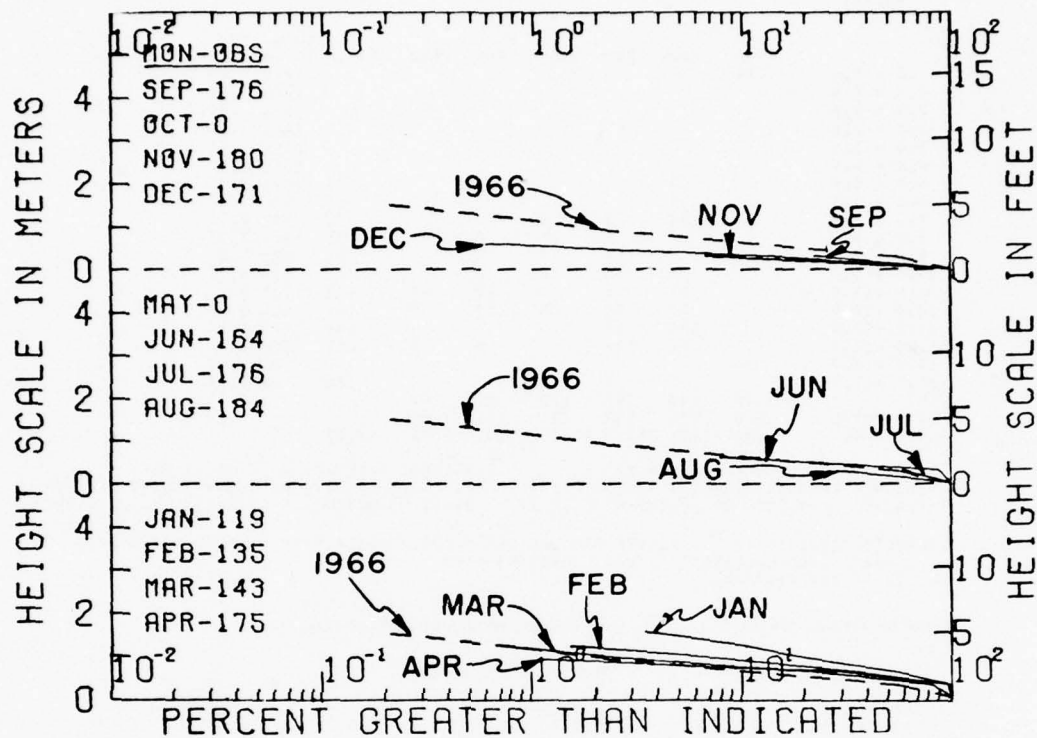


Figure A-102. Seasonal summaries of cumulative significant height distributions from Venice, California. Determined from 7-minute pen and ink records taken six times daily. Wave heights may be low due to old gage design and maintenance difficulties.

Table A-64. Wave climate for Venice, California.
Distribution of significant height versus period
(in observations per 1,000 observations).

119 OBSERVATIONS							SUMMARY FOR JAN 66		
PERIOD (SECS)	HEIGHT (FT)								
	0=1	1=2	2=3	3=4	4=5	5=6	TOT.	CUM. TOT.	RO- AVG.
0.0 = 1.9	25							1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9								1000	.00
4.0 = 4.9								1000	.00
5.0 = 5.9		25					25	1000	1.50
6.0 = 6.9		17					17	974	1.50
7.0 = 7.9		34	8	8			52	957	2.00
8.0 = 8.9		17	8	17	8		52	905	2.83
9.0 = 9.9		8	17	17	8		52	853	3.00
10.0 = 10.9		25	25	34	8		95	802	2.77
11.0 = 11.9		50	8	8	17	17	103	707	2.92
12.0 = 12.9		59	50	25	17	8	164	603	2.66
13.0 = 13.9		109	50				164	440	1.82
14.0 = 14.9		92	134		8	8	250	276	2.29
15.0 = 15.9								26	.00
16.0 = 16.9		8	17				26	26	2.17
TOTAL	25	445	319	109	67	34			2.35
CUM. TOTAL	1000	975	529	210	101	34			
COL. AVG.	.00	11.80	13.13	10.35	11.37	12.50	12.07		

AVERAGE SIG. HEIGHT = 2.35 FT AVERAGE WAVE PERIOD = 12.07 SEC
 VARIANCE OF SIG. HEIGHT = 1.20 FT SQ VARIANCE OF WAVE PERIOD = 6.35 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.10 FT STANDARD DEVIATION OF PERIOD = 2.52 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT VENICE FISHING PIER
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

135 OBSERVATIONS							SUMMARY FOR FEB 66		
PERIOD (SECS)	HEIGHT (FT)								
	0=1	1=2	2=3	3=4	4=5	5=6	TOT.	CUM. TOT.	RO- AVG.
0.0 = 1.9								1000	.00
2.0 = 2.4								1000	.00
2.5 = 2.9								1000	.00
3.0 = 3.4								1000	.00
3.5 = 3.9	7	22					30	993	1.25
4.0 = 4.9		22					22	963	1.50
5.0 = 5.9		52					52	941	1.50
6.0 = 6.9		52	30				81	889	1.84
7.0 = 7.9		111	44				156	807	1.79
8.0 = 8.9	7	52	37	7			104	652	1.93
9.0 = 9.9	15	52	22				89	548	1.58
10.0 = 10.9	7	15	44	7			74	459	2.20
11.0 = 11.9		22	15	7			44	385	2.17
12.0 = 12.9		74	7	7			89	341	1.75
13.0 = 13.9		22	22	15	7		67	252	2.61
14.0 = 14.9		96	30	22	7		156	185	2.12
15.0 = 15.9								30	.00
16.0 = 16.9		30					30	30	1.50
TOTAL	37	630	252	67	15				1.89
CUM. TOTAL	1000	963	333	81	15				
COL. AVG.	8.35	9.72	9.97	12.61	14.00		9.99		

AVERAGE SIG. HEIGHT = 1.89 FT AVERAGE WAVE PERIOD = 9.99 SEC
 VARIANCE OF SIG. HEIGHT = .53 FT SQ VARIANCE OF WAVE PERIOD = 11.34 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .73 FT STANDARD DEVIATION OF PERIOD = 3.37 SEC

143 OBSERVATIONS

SUMMARY FOR MAR 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	TOT.*	CUM. TOT.*	NO. AVG.*
1.0 = 1.9	77						1000	.00
2.0 = 2.4							1000	.00
2.5 = 2.9							1000	.00
3.0 = 3.4							1000	.00
3.5 = 3.9		7				8	1000	1.50
4.0 = 4.9		14	7			23	992	1.83
5.0 = 5.9		42	14	7		68	970	1.94
6.0 = 6.9	21	28		7		61	902	1.37
7.0 = 7.9	7	56	7	7	7	91	841	1.92
8.0 = 8.9	21	35	7			68	740	1.28
9.0 = 9.9	7	35				45	682	1.33
10.0 = 10.9	28	63				98	636	1.19
11.0 = 11.9	14	56				76	538	1.30
12.0 = 12.9	7	70	35			121	462	1.75
13.0 = 13.9	14	105	70			205	341	1.80
14.0 = 14.9	21	56	42			129	136	1.68
15.0 = 15.9							8	.00
16.0 = 16.9	7					8	8	.50
TOTAL	224	566	182	21	7			1.52
CUM. TOTAL	1000	776	210	28	7			
COL. AVG.	10.79	10.52	12.15	6.50	7.50	10.77		

AVERAGE SIG. HEIGHT = 1.52 FT

AVERAGE WAVE PERIOD = 10.77 SEC

VARIANCE OF SIG. HEIGHT = .55 FT SQ

VARIANCE OF WAVE PERIOD = 9.64 SEC SQ

STANDARD DEVIATION OF HEIGHT = .74 FT

STANDARD DEVIATION OF PERIOD = 3.10 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

WAVE GAGE LOCATED AT VENICE FISHING PIER

* CALMS ARE OMITTED.

175 OBSERVATIONS

SUMMARY FOR APR 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	TOT.*	CUM. TOT.*	NO. AVG.*
1.0 = 1.9						1000	.00
2.0 = 2.4						1000	.00
2.5 = 2.9						1000	.00
3.0 = 3.4						1000	.00
3.5 = 3.9		29			29	1000	1.50
4.0 = 4.9		17	11		29	971	1.90
5.0 = 5.9		34	34		69	943	2.00
6.0 = 6.9	6	29	6		40	874	1.50
7.0 = 7.9	6	34	46		86	834	1.97
8.0 = 8.9		17			17	749	1.50
9.0 = 9.9		34	6		40	731	1.84
10.0 = 10.9		34	11		46	691	1.75
11.0 = 11.9		17			17	646	1.50
12.0 = 12.9	6	63	23		91	629	1.69
13.0 = 13.9	6	114	11		131	537	1.54
14.0 = 14.9	29	189	109	6	331	406	1.78
15.0 = 15.9		11	6		17	74	1.83
16.0 = 16.9		34	17	6	57	57	2.00
TOTAL	51	657	280	11			1.75
CUM. TOTAL	1000	949	291	11			
COL. AVG.	12.50	11.64	11.36	15.50	11.65		

AVERAGE SIG. HEIGHT = 1.75 FT

AVERAGE WAVE PERIOD = 11.65 SEC

VARIANCE OF SIG. HEIGHT = .31 FT SQ

VARIANCE OF WAVE PERIOD = 13.60 SEC SQ

STANDARD DEVIATION OF HEIGHT = .56 FT

STANDARD DEVIATION OF PERIOD = 3.69 SEC

Wave heights may be low due to old gage design and maintenance difficulties.

Insufficient data for May.

164 OBSERVATIONS

SUMMARY FOR JUN 66

PERIOD (SECS)	HEIGHT (FT)			CUM. ROW		
	0=1	1=2	2=3	TOT.*	TOT.*	AVG.*
1.0 = 1.9					1000	.00
2.0 = 2.4					1000	.00
2.5 = 2.9					1000	.00
3.0 = 3.4					1000	.00
3.5 = 3.9		6		6	1000	1.50
4.0 = 4.9	6	24		30	994	1.30
5.0 = 5.9	6	55		61	963	1.40
6.0 = 6.9	12	73		85	902	1.36
7.0 = 7.9	30	67		98	817	1.19
8.0 = 8.9	18	30		49	720	1.12
9.0 = 9.9		37		37	671	1.50
10.0 = 10.9	6	12		18	634	1.17
11.0 = 11.9	12	24		37	616	1.17
12.0 = 12.9	6	18		24	579	1.25
13.0 = 13.9	6	98	12	116	555	1.55
14.0 = 14.9	18	256	37	311	439	1.56
15.0 = 15.9					128	.00
16.0 = 16.9	12	85	30	128	128	1.64
TOTAL	134	787	79			1.45
CUM. TOTAL	1000	866	79			
COL. AVG.	10.09	11.56	15.12	11.65		

AVERAGE SIG. HEIGHT = 1.45 FT
 VARIANCE OF SIG. HEIGHT = .21 FT SQ
 STANDARD DEVIATION OF HEIGHT = .46 FT

AVERAGE WAVE PERIOD = 11.65 SEC
 VARIANCE OF WAVE PERIOD = 14.82 SEC SQ
 STANDARD DEVIATION OF PERIOD = 3.85 SEC

176 OBSERVATIONS

SUMMARY FOR JUL 66

PERIOD (SECS)	HEIGHT (FT)			CUM. ROW		
	0=1	1=2	TOT.*	TOT.*	AVG.*	
1.0 = 1.9	51				1000	.00
2.0 = 2.4					1000	.00
2.5 = 2.9					1000	.00
3.0 = 3.4	6		6	6	1000	.50
3.5 = 3.9	6	11	18	994	1.17	
4.0 = 4.9	6	34	42	976	1.36	
5.0 = 5.9	62	28	96	934	.81	
6.0 = 6.9	40	40	84	838	1.00	
7.0 = 7.9	34	28	66	754	.95	
8.0 = 8.9	17		18	689	.50	
9.0 = 9.9	23	11	36	671	.83	
10.0 = 10.9	6	23	30	635	1.30	
11.0 = 11.9	6		6	605	.50	
12.0 = 12.9	11	11	24	599	1.00	
13.0 = 13.9	45	45	96	575	1.00	
14.0 = 14.9	85	250	333	479	1.25	
15.0 = 15.9	6	34	42	126	1.36	
16.0 = 16.9	6	74	84	84	1.43	
TOTAL	409	591			1.09	
CUM. TOTAL	1000	591				
COL. AVG.	10.01	12.35	11.47			

AVERAGE SIG. HEIGHT = 1.09 FT
 VARIANCE OF SIG. HEIGHT = .24 FT SQ
 STANDARD DEVIATION OF HEIGHT = .49 FT

AVERAGE WAVE PERIOD = 11.47 SEC
 VARIANCE OF WAVE PERIOD = 16.83 SEC SQ
 STANDARD DEVIATION OF PERIOD = 4.10 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT VENICE FISHING PIER
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

164 OBSERVATIONS

SUMMARY FOR AUG 66

PERIOD (SECS)	HEIGHT (FT)				CUM. ROW	
	0=1	1=2	TOT.*	TOT.*	AVG.*	
.0 = 1.9	201			1000	.00	
2.0 = 2.4				1000	.00	
2.5 = 2.9				1000	.00	
3.0 = 3.4	16		20	1000	.50	
3.5 = 3.9	16		20	980	.50	
4.0 = 4.9	11	22	41	959	1.17	
5.0 = 5.9	16	11	34	918	.90	
6.0 = 6.9	16	5	27	884	.75	
7.0 = 7.9	5	5	14	857	1.00	
8.0 = 8.9	5		7	844	.50	
9.0 = 9.9				837	.00	
10.0 = 10.9	16		20	837	.50	
11.0 = 11.9	33		41	816	.50	
12.0 = 12.9	54	11	82	776	.67	
13.0 = 13.9	71	11	102	694	.63	
14.0 = 14.9	190	103	367	592	.85	
15.0 = 15.9	5		7	224	.50	
16.0 = 16.9	60	114	218	218	1.16	
TOTAL	717	283			.78	
CUM. TOTAL	1000	283				
COL. AVG.	12.50	13.79	12.96			

AVERAGE SIG. HEIGHT = .78 FT
 VARIANCE OF SIG. HEIGHT = .20 FT SQ
 STANDARD DEVIATION OF HEIGHT = .45 FT

AVERAGE WAVE PERIOD = 12.96 SEC*
 VARIANCE OF WAVE PERIOD = 14.05 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 3.75 SEC*

176 OBSERVATIONS

SUMMARY FOR SEP 66

PERIOD (SECS)	HEIGHT (FT)				CUM. ROW	
	0=1	1=2	TOT.*	TOT.*	AVG.*	
.0 = 1.9	233			1000	.00	
2.0 = 2.4				1000	.00	
2.5 = 2.9				1000	.00	
3.0 = 3.4	11	6	22	1000	.83	
3.5 = 3.9	6	6	15	978	1.00	
4.0 = 4.9	34		44	963	.50	
5.0 = 5.9	108		141	919	.50	
6.0 = 6.9	125	40	215	778	.74	
7.0 = 7.9	51	97	193	563	1.15	
8.0 = 8.9	6	6	15	370	1.00	
9.0 = 9.9				356	.00	
10.0 = 10.9				356	.00	
11.0 = 11.9	11		15	356	.50	
12.0 = 12.9	6		7	341	.50	
13.0 = 13.9	17	6	30	333	.75	
14.0 = 14.9	114	17	170	304	.63	
15.0 = 15.9	11		15	133	.50	
16.0 = 16.9	45	40	111	119	.97	
17.0 = 17.9				7	.00	
18.0 = 18.9		6	7	7	1.50	
TOTAL	778	222			.72	
CUM. TOTAL	1000	222				
COL. AVG.	9.27	9.73	9.40			

AVERAGE SIG. HEIGHT = .72 FT
 VARIANCE OF SIG. HEIGHT = .17 FT SQ
 STANDARD DEVIATION OF HEIGHT = .42 FT

AVERAGE WAVE PERIOD = 9.40 SEC*
 VARIANCE OF WAVE PERIOD = 18.87 SEC SQ*
 STANDARD DEVIATION OF PERIOD = 4.34 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A 32EP RESISTANCE
 WAVE GAGE LOCATED AT VENICE FISHING PIER
 * CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

Insufficient data for October.

180 OBSERVATIONS

SUMMARY FOR NOV 66

PERIOD (SECS) HEIGHT (FT)

	0=1	1=2	TOT.*	CUM. TOT.*	ROW AVG.*
.0 ~ 1.9	400			1000	.00
2.0 ~ 2.4				1000	.00
2.5 ~ 2.9				1000	.00
3.0 ~ 3.4	17	6	37	1000	.75
3.5 ~ 3.9	17		28	963	.50
4.0 ~ 4.9	33		56	935	.50
5.0 ~ 5.9	61		102	880	.50
6.0 ~ 6.9	194	17	352	778	.58
7.0 ~ 7.9	172	28	333	426	.64
8.0 ~ 8.9	33	17	83	93	.83
9.0 ~ 9.9	6		9	9	.50
TOTAL	933	67			.97
CUM. TOTAL	1000	67			
COL. AVG.	6.55*	7.15	6.62		

AVERAGE SIG. HEIGHT = .57 FT AVERAGE WAVE PERIOD = 6.62 SEC*
 VARIANCE OF SIG. HEIGHT = .06 FT SQ VARIANCE OF WAVE PERIOD = 1.66 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .25 FT STANDARD DEVIATION OF PERIOD = 1.29 SEC*

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT VENICE FISHING PIER
 * CALMS ARE OMITTED.

171 OBSERVATIONS

SUMMARY FOR DEC 66

PERIOD (SECS) HEIGHT (FT)

	0=1	1=2	2=3	TOT.*	CUM. TOT.*	ROW AVG.*
.0 ~ 1.9	316				1000	.00
2.0 ~ 2.4					1000	.00
2.5 ~ 2.9					1000	.00
3.0 ~ 3.4	41	18	6	94	1000	.95
3.5 ~ 3.9	53	18		103	906	.75
4.0 ~ 4.9	58	35		137	803	.88
5.0 ~ 5.9	94	12		154	667	.61
6.0 ~ 6.9	164	12		256	513	.57
7.0 ~ 7.9	123	23		214	256	.66
8.0 ~ 8.9	12	12		34	43	1.00
9.0 ~ 9.9	6			9	9	.50
TOTAL	865	129	6			.64
CUM. TOTAL	1000	135	6			
COL. AVG.	5.91*	5.41	3.25	5.79		

AVERAGE SIG. HEIGHT = .64 FT AVERAGE WAVE PERIOD = 5.79 SEC*
 VARIANCE OF SIG. HEIGHT = .13 FT SQ VARIANCE OF WAVE PERIOD = 2.40 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = .36 FT STANDARD DEVIATION OF PERIOD = 1.55 SEC*

Wave heights may be low due to old gage design and maintenance difficulties.

1623 OBSERVATIONS

SUMMARY FOR 10 MONTHS JAN 66 THROUGH DEC 66

PERIOD
(SECS)

HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	TOT.*	CUM. TOT.*	RO- TOT.*	AVG.*
0.0 = 1.9	140							1000	.00	
2.0 = 2.4								1000	.00	
2.5 = 2.9								1000	.00	
3.0 = 3.4	10	4	1				16	1000	.85	
3.5 = 3.9	11	10					24	984	.97	
4.0 = 4.9	16	17	2				41	959	1.10	
5.0 = 5.9	38	25	5	1			79	918	1.04	
6.0 = 6.9	62	31	3	1			112	840	.90	
7.0 = 7.9	46	47	10	1	1		122	727	1.19	
8.0 = 8.9	12	17	4	2	1		42	605	1.43	
9.0 = 9.9	6	17	4	1	1		32	563	1.59	
10.0 = 10.9	6	16	7	3	1		38	531	1.76	
11.0 = 11.9	8	15	2	1	1	1	33	493	1.67	
12.0 = 12.9	10	28	10	2	1	1	60	460	1.71	
13.0 = 13.9	17	48	14	1	1		95	400	1.52	
14.0 = 14.9	50	107	31	2	1	1	223	305	1.46	
15.0 = 15.9	2	5	1				9	82	1.27	
16.0 = 16.9	14	41	6	1			72	72	1.39	
17.0 = 17.9								1	.00	
18.0 = 18.9		1					1	1	1.50	
TOTAL	449	426	99	17	7	2			1.21	
CUM. TOTAL	1000	551	125	26	9	2				
COL. AVG.	8.97	11.16	11.86	11.06	11.50	12.50	10.46			

AVERAGE SIG. HEIGHT = 1.21 FT

AVERAGE WAVE PERIOD = 10.45 SEC

VARIANCE OF SIG. HEIGHT = .63 FT SQ

VARIANCE OF WAVE PERIOD = 16.10 SEC SQ

STANDARD DEVIATION OF HEIGHT = .80 FT

STANDARD DEVIATION OF PERIOD = 4.01 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND INK RECORDS TAKEN WITH A STEP RESISTANCE

WAVE GAGE LOCATED AT VENICE FISHING PIER

* CALMS ARE OMITTED.

Wave heights may be low due to old gage design and maintenance difficulties.

Table A-65. CERC wave gage history for Huntington Beach Fishing Pier, Huntington Beach, California.

CERC Form 174-74

15 Mar 74

COORDINATES: 33° 39' N., 118° 00' W.

LOCATION: Huntington Beach Fishing Pier, Huntington Beach, California

Type of Gage	Beginning of Proper Operation	End of Proper Operation	Explanation	Gage Length (feet)	Gage Range (ft MSL)	Water Depth (ft MSL)	Distance from seaward end of pier	Pier Length (feet)
Step-resistance (SR), staff-spark plug type	28 May 1948	14 July 1949		24		26	0	1,500
SR staff-parallel type	8 Sept. 1949	19 Nov. 1953	Gage out of order; marine growth.	25		26	0	1,500
	7 Feb. 1955	24 Apr. 1958						
	20 June 1958	28 May 1969	New gage installed.					
SR staff-relay type	19 July 1969	24 Feb. 1970		25			0	1,500
	28 May 1970	12 Mar. 1971	Gage removed.					
Continuous-wire staff	13 Oct. 1971	17 Sept. 1975	Gage discontinued.	25	-13 to +12	30	0	1,500

Table A-66. Number of analyzed records from Huntington Beach, California.¹

MO YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1948				24	126	117	127	161	161	86	114		916
1949	53	17	137	27	100	137	86		148	138	145	176	1164
1950	27	88	114	31	104	174	186	174	180	186	180	179	1623
1951	186	168	186	172	170	134	61	186	180	185	180	186	1984
1952	183	171	179	180	186	180	175	186	177	143	180	186	2126
1953	186	165	166	136	178	178	183	174	168	186	117		1827
1954													
1955		105	187	174	180	166	174	181	182	182	179	176	1826
1956	186	174	186	179	182	180	179	180	178	186	180	186	2176
1957	186	167	186	180	186	172	186	178	180	181	180	186	2168
1958	186	168	186	150		80	185	186	179	185	159	186	1850
1959	76	168	186	180	176	180	177	183	180	186	179	186	2056
1960	180	174	185	176	144	176	186	174	168	181	169	167	2080
1961	185	168	186	180	186	180	192	63	141	124	141	146	1872
1962	141	96	49	15	26	60	8	181	180	186	180	186	1308
1963	186	168	175	165	185	180	186	186	180	133	175	185	2104
1964	186	174	186	174	186	180	185	186	178	186	175	186	2183
1965	182	168	186	171	186	180	186	186	180	186	172	181	2182
1966	185	168	186	179	186	180	186	176	65	179	157	129	1875
1967	58	168	118	114	38								494
1968													
1969													
1970													
1971													
1972		105	119	102	110	113	80	109	86	94	73	61	1042
1973	53	80	78	63	93	91	84	90	86	83	108	69	936
1974	101	102	83	80	88	86	87	85	84	101	105	115	1127
1975	101												

¹Results before 1968 obtained from 7-minute pen and ink records taken six times daily; analyzed by the first BEB method for 1948 to 1953; analyzed by the second BEB method for 1954 to February 1964; and analyzed by the CERC method for March 1964 to 1967. Results after January 1972 obtained from 1,024-second digital records taken four times daily.

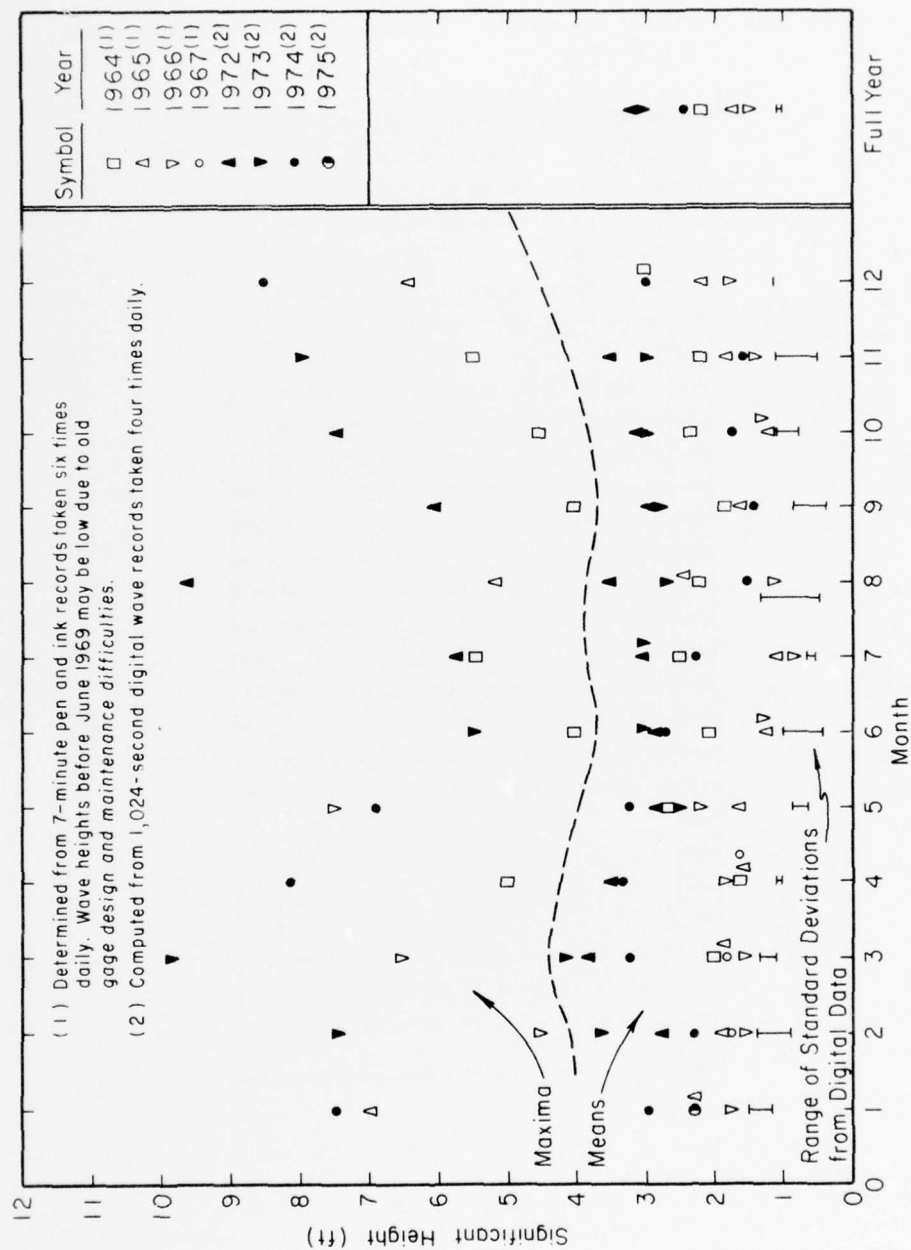


Figure A-103. Maxima, means, and standard deviations of significant height from Huntington Beach, California.

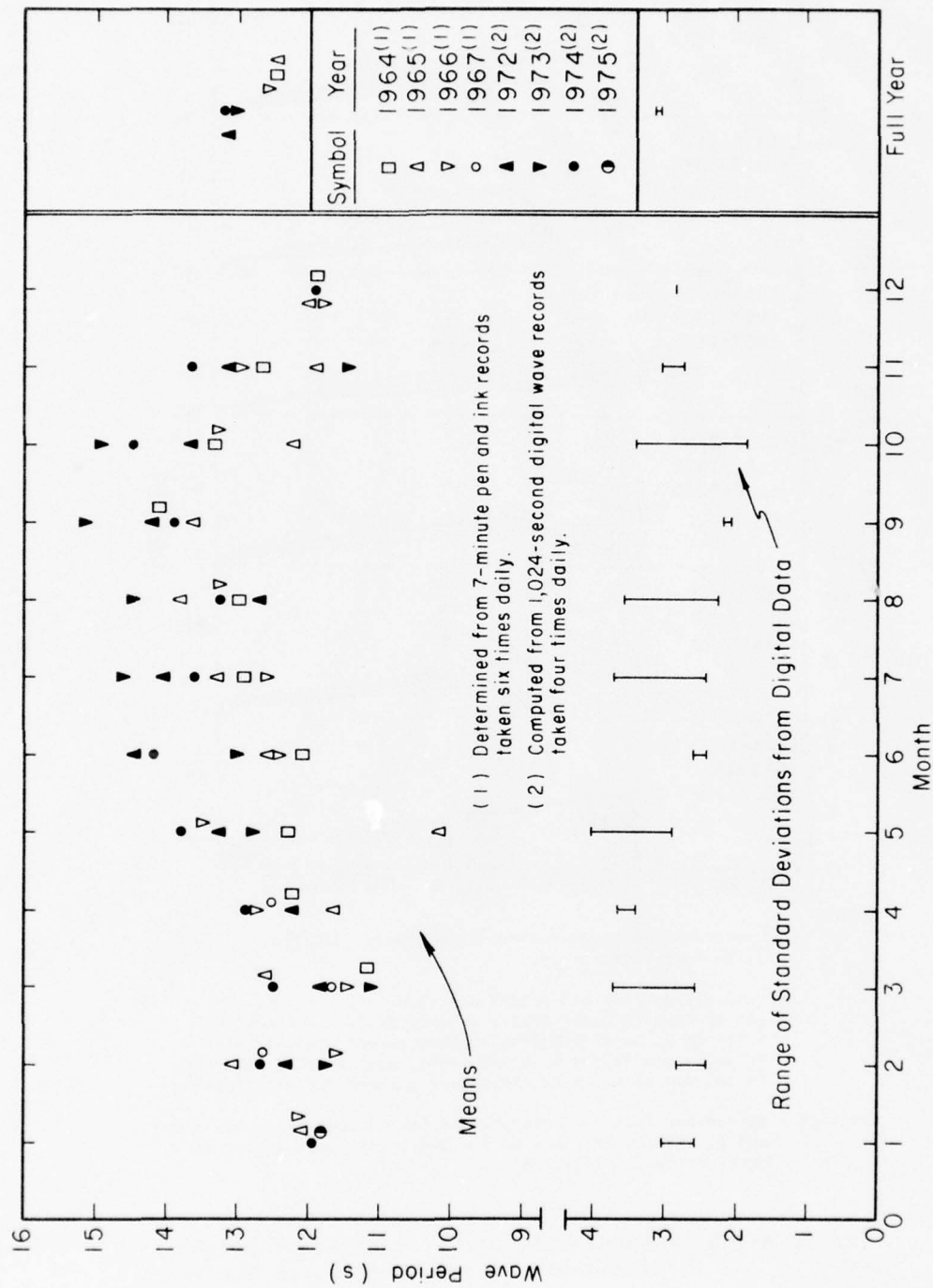
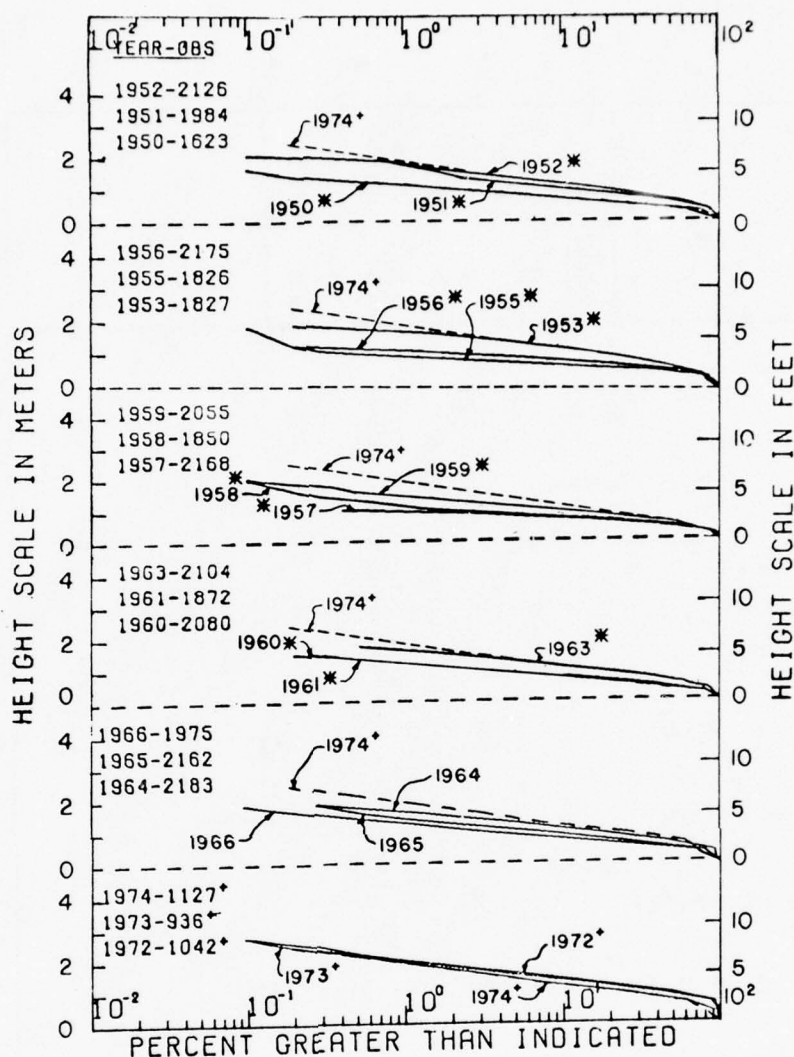


Figure A-104. Means and standard deviations of wave periods for Huntington Beach, California.



NOTE:

- + = computed from 1,024-second digital wave records taken four times daily.
- * = determined by an old analysis method from 7-minute pen and ink records taken six times daily and compensated to compare with results from recent analysis methods (see Tables A-68 and A-69); wave heights may be low due to old gage design and maintenance difficulties.

Unmarked = determined from 7-minute pen and ink records taken six times daily; wave heights may be low due to old gage design and maintenance difficulties.

Figure A-105. Annual cumulative significant height distributions from Huntington Beach, California.

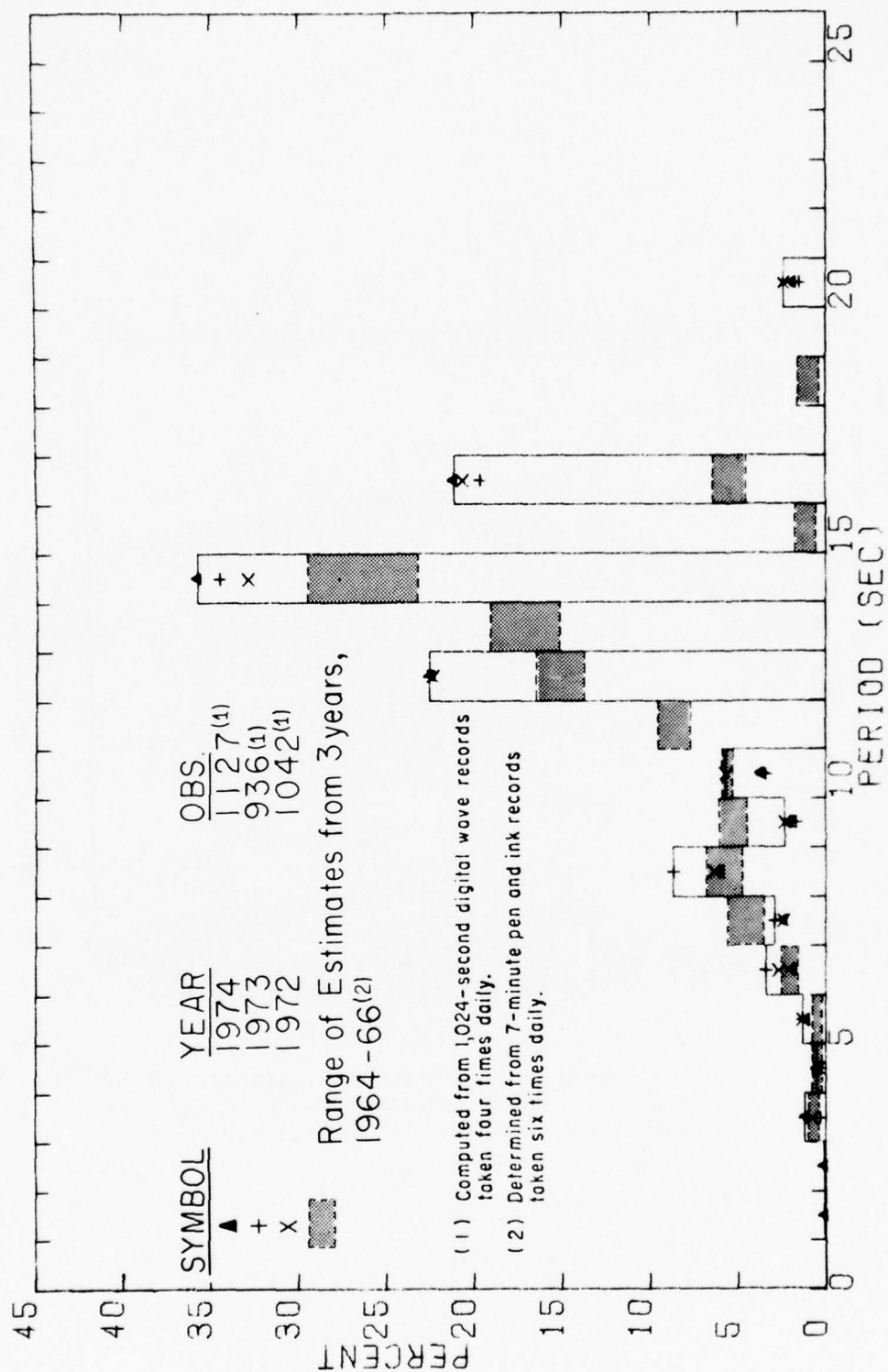


Figure A-106. Annual significant period distributions from Huntington Beach, California.

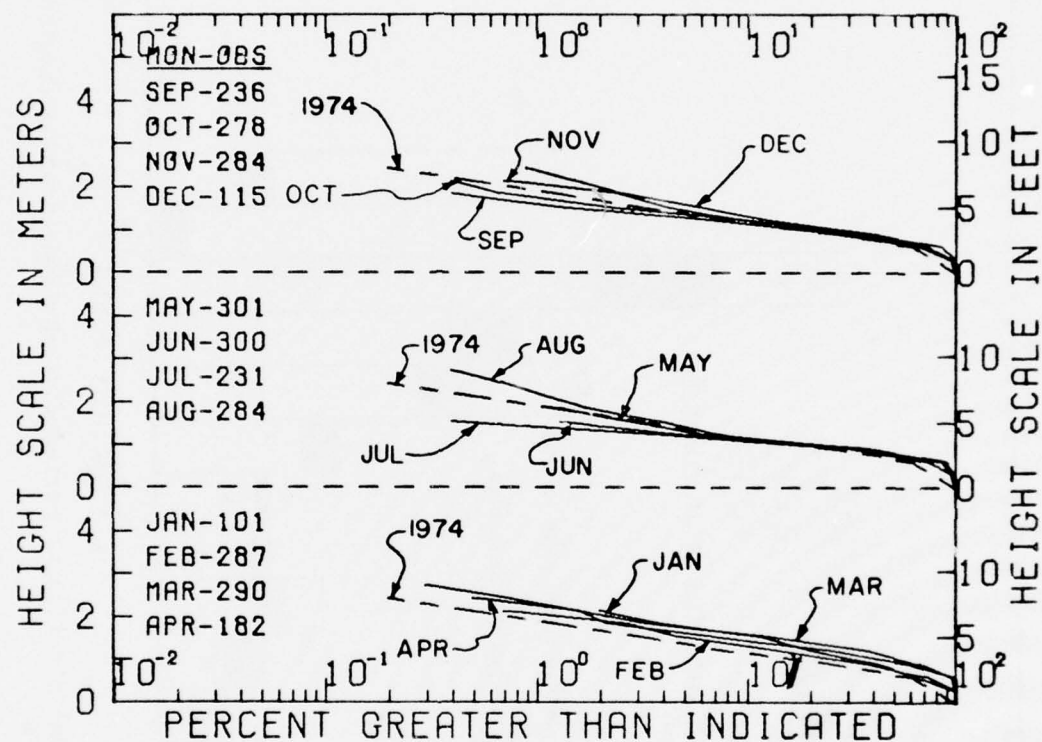


Figure A-107. Seasonal summaries of cumulative significant height distributions from Huntington Beach, California. Computed from 1,024-second digital wave records taken four times daily.

Table A-67. Wave climate for Huntington Beach, California.
Distribution of significant height versus period
(in observations per 1,000 observations).

101 OBSERVATIONS										SUMMARY FOR JAN 74									
PERIOD (SECS)										SIG. HEIGHT (FT)									
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW								AVG.*
0.0 - .9										1000	0.00								
1.0 - 1.9										1000	0.00								
2.0 - 2.9										1000	0.00								
3.0 - 3.9				20					20	1000	3.50								
4.0 - 4.9				20					20	980	3.50								
5.0 - 5.9				10					10	960	3.50								
6.0 - 6.9		20						10	30	950	3.50								
7.0 - 7.9			10			10			20	921	4.00								
8.0 - 8.9			20	20	40	10	20	10	119	901	4.67								
9.0 - 9.9		10	10						20	782	2.00								
10.0 - 10.9			10	20					30	762	3.17								
11.0 - 11.9										733	0.00								
12.0 - 12.9		158	119	69	10	30			386	733	2.55								
13.0 - 13.9										347	0.00								
14.0 - 14.9		89	30	59	40	30			248	347	3.06								
15.0 - 15.9										99	0.00								
16.0 - 16.9		69	30						99	99	1.80								
TOTAL		347	228	218	89	79	20	20			2.97								
CUM. TOTAL	1000	1000	653	426	208	119	40	20											
COL. AVG.	0.00	13.30	12.50	10.64	11.61	12.13	8.50	7.50	12.11										

AVERAGE SIG. HEIGHT = 2.95 FT AVERAGE WAVE PERIOD = 11.94 SEC*
 VARIANCE OF SIG. HEIGHT = 2.17 FT SQ VARIANCE OF WAVE PERIOD = 9.28 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.47 FT STANDARD DEVIATION OF PERIOD = 3.04 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.
 * CALMS ARE OMITTED.

287 OBSERVATIONS										SUMMARY FOR FEB 72 FEB 73 FEB 74									
PERIOD (SECS)										SIG. HEIGHT (FT)									
	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW								AVG.*
0.0 - .9										1000	0.00								
1.0 - 1.9										1000	0.00								
2.0 - 2.9										1000	0.00								
3.0 - 3.9			3						3	1000	2.50								
4.0 - 4.9					3				3	997	4.50								
5.0 - 5.9		14		3	3				24	993	3.07								
6.0 - 6.9				7	7				17	969	4.70								
7.0 - 7.9		3	3	17			3		28	951	3.50								
8.0 - 8.9		10	24	17	3	3			59	923	2.91								
9.0 - 9.9	3	3	21						28	864	2.13								
10.0 - 10.9		31	45	17	3		3		101	836	2.57								
11.0 - 11.9										735	0.00								
12.0 - 12.9		111	122	98	42	7	3		383	735	2.77								
13.0 - 13.9										352	0.00								
14.0 - 14.9		49	101	49	24	7	7		237	352	2.91								
15.0 - 15.9										115	0.00								
16.0 - 16.9		31	42	24	10	3	3		119	115	2.83								
TOTAL	3	254	362	233	98	21	21	7			2.85								
CUM. TOTAL	1000	997	742	380	146	49	28	7											
COL. AVG.	9.50	12.47	12.69	12.23	12.25	13.17	12.67	6.00	12.44										

AVERAGE SIG. HEIGHT = 2.85 FT AVERAGE WAVE PERIOD = 12.31 SEC*
 VARIANCE OF SIG. HEIGHT = 1.35 FT SQ VARIANCE OF WAVE PERIOD = 7.05 SEC SQ*
 STANDARD DEVIATION OF HEIGHT = 1.16 FT STANDARD DEVIATION OF PERIOD = 2.66 SEC*

290 OBSERVATIONS

SUMMARY FOR MAR 72 MAR 73 MAR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	9=10	TOT.	CUM. TOT.	ROW AVG.
0.0 = .9												1000	0.00
1.0 = 1.9												1000	0.00
2.0 = 2.9												1000	0.00
3.0 = 3.9												1000	0.00
4.0 = 4.9				3		3					10	1000	3.83
5.0 = 5.9			3	7	7		3				21	990	4.17
6.0 = 6.9			3	17	21						41	969	3.92
7.0 = 7.9			3	21	21	10	3				59	928	4.32
8.0 = 8.9		10	14	38	31	21	10		3	3	131	869	4.32
9.0 = 9.9		3	7	14							24	738	2.93
10.0 = 10.9		7	28	3	17	3					59	714	3.21
11.0 = 11.9												655	0.00
12.0 = 12.9		7	90	76	69	28	7				276	655	3.65
13.0 = 13.9												379	0.00
14.0 = 14.9		10	90	86	62	21	3				272	379	3.51
15.0 = 15.9												107	0.00
16.0 = 16.9			38	28	31	3					100	107	3.50
17.0 = 17.9												7	0.00
18.0 = 18.9												7	0.00
19.0 = 19.9												7	0.00
20.0 = 20.9				3		3					7	7	4.00
21.0 +													0.00
TOTAL		38	283	293	259	93	28		3	3			3.71
CUM. TOTAL	1000	1000	962	679	386	128	34	7	7	3			
COL. AVG.	0.00	11.32	12.99	11.82	11.78	11.57	9.75	0.00	8.50	8.50	12.02		

AVERAGE SIG. HEIGHT = 3.70 FT

AVERAGE WAVE PERIOD = 11.87 SEC

VARIANCE OF SIG. HEIGHT = 1.48 FT SQ

VARIANCE OF WAVE PERIOD = 9.72 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.22 FT

STANDARD DEVIATION OF PERIOD = 3.12 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER,

* CALMS ARE OMITTED.

182 OBSERVATIONS

SUMMARY FOR APR 72 APR 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	8=9	TOT.	CUM. TOT.	ROW AVG.	
0.0 - .9											1000	0.00	
1.0 - 1.9											1000	0.00	
2.0 - 2.9											1000	0.00	
3.0 - 3.9											1000	0.00	
4.0 - 4.9											1000	0.00	
5.0 - 5.9		5	16	5	11					38	1000	3.07	
6.0 - 6.9			27	4	22	5		5		66	967	3.92	
7.0 - 7.9			11		5	11				27	896	4.10	
8.0 - 8.9			16	38	60	11		5	5	137	868	4.30	
9.0 - 9.9			5		11					16	731	3.83	
10.0 - 10.9				11	5	11				27	714	4.50	
11.0 - 11.9												687	0.00
12.0 - 12.9			44	60	22					126	687	3.33	
13.0 - 13.9												560	0.00
14.0 - 14.9		5	209	115	33	5		5		374	560	3.09	
15.0 - 15.9												187	0.00
16.0 - 16.9			38	93	22	5				159	187	3.47	
17.0 - 17.9												27	0.00
18.0 - 18.9												27	0.00
19.0 - 19.9												27	0.00
20.0 - 20.9				22	5					27	27	2.70	
21.0 +												0.00	
TOTAL		11	390	335	192	49	5	11	5			3.47	
CUM. TOTAL	1000	1000	989	599	264	71	22	16	5				
COL. AVG.	0.00	10.00	13.35	13.70	10.59	10.06	8.50	10.50	8.50	12.65			

AVERAGE SIG. HEIGHT = 3.44 FT

AVERAGE WAVE PERIOD = 12.60 SEC

VARIANCE OF SIG. HEIGHT = 1.09 FT SQ

VARIANCE OF WAVE PERIOD = 12.77 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.04 FT

STANDARD DEVIATION OF PERIOD = 3.57 SEC

301 OBSERVATIONS

SUMMARY FOR MAY 72 MAY 73 MAY 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9									1000	0.00
1.0 - 1.9									1000	0.00
2.0 - 2.9									1000	0.00
3.0 - 3.9			3	20				23	1000	3.36
4.0 - 4.9				3				3	977	3.50
5.0 - 5.9			3	13				17	973	3.30
6.0 - 6.9		3	13	3				20	957	2.50
7.0 - 7.9			3	17	10		7	37	937	4.23
8.0 - 8.9		7	13	33	17		7	76	900	3.63
9.0 - 9.9		3		3				7	824	2.50
10.0 - 10.9		13	3					17	817	1.70
11.0 - 11.9									801	0.00
12.0 - 12.9		33	86	20				140	801	2.40
13.0 - 13.9									661	0.00
14.0 - 14.9		27	252	90	10			379	661	2.72
15.0 - 15.9									282	0.00
16.0 - 16.9		7	140	103	17			266	282	2.99
17.0 - 17.9									17	0.00
18.0 - 18.9									17	0.00
19.0 - 19.9									17	0.00
20.0 - 20.9				3	13			17	17	3.30
21.0 +										0.00
TOTAL		93	422	319	53		13			2.80
CUM. TOTAL	1000	1000	907	384	66	13	13			
COL. AVG.	0.00	12.46	14.19	12.98	11.94	0.00	8.00	13.84		

AVERAGE SIG. HEIGHT = 2.87 FT AVERAGE WAVE PERIOD = 13.29 SEC
 VARIANCE OF SIG. HEIGHT = .57 FT SQ VARIANCE OF WAVE PERIOD = 11.96 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .75 FT STANDARD DEVIATION OF PERIOD = 3.46 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.
 * CALMS ARE OMITTED.

300 OBSERVATIONS

SUMMARY FOR JUN 72 JUN 73 JUN 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9								1000	0.00
1.0 - 1.9								1000	0.00
2.0 - 2.9								1000	0.00
3.0 - 3.9				3			3	1000	3.50
4.0 - 4.9								997	0.00
5.0 - 5.9								997	0.00
6.0 - 6.9		3	10	7			20	997	2.67
7.0 - 7.9			7	7			13	977	3.00
8.0 - 8.9		10	23	7		3	43	963	2.65
9.0 - 9.9			10	3			13	920	2.75
10.0 - 10.9		3	3	7			13	907	2.75
11.0 - 11.9								893	0.00
12.0 - 12.9		33	83	27	13	3	160	893	2.69
13.0 - 13.9								733	0.00
14.0 - 14.9		27	283	147	10	3	470	733	2.82
15.0 - 15.9								263	0.00
16.0 - 16.9		3	120	93	17	3	237	263	3.06
17.0 - 17.9								27	0.00
18.0 - 18.9								27	0.00
19.0 - 19.9								27	0.00
20.0 - 20.9			17	10			27	27	2.88
21.0 +									0.00
TOTAL		80	557	310	40	13			2.85
CUM. TOTAL	1000	1000	920	363	53	13			
COL. AVG.	0.00	12.50	14.22	14.41	14.67	13.00	14.14		

AVERAGE SIG. HEIGHT = 2.84 FT AVERAGE WAVE PERIOD = 13.97 SEC
 VARIANCE OF SIG. HEIGHT = .45 FT SQ VARIANCE OF WAVE PERIOD = 6.87 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .67 FT STANDARD DEVIATION OF PERIOD = 2.62 SEC

230 OBSERVATIONS

SUMMARY FOR JUL 72 JUL 73 JUL 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	TOT.*	CUM. TOT.*	RDW. AVG.*
0.0 - .9							1000	0.00
1.0 - 1.9							1000	0.00
2.0 - 2.9							1000	0.00
3.0 - 3.9			13	9		22	1000	2.90
4.0 - 4.9		9		4		13	978	2.17
5.0 - 5.9							965	0.00
6.0 - 6.9		4	9			13	965	2.17
7.0 - 7.9			17			17	952	2.50
8.0 - 8.9		4	26			30	935	2.36
9.0 - 9.9			4			4	904	2.50
10.0 - 10.9		4	4	17		26	900	3.00
11.0 - 11.9							874	0.00
12.0 - 12.9		17	135	30	4	187	874	2.62
13.0 - 13.9							687	0.00
14.0 - 14.9		57	152	91	4	304	687	2.64
15.0 - 15.9							383	0.00
16.0 - 16.9		48	152	113	30	343	383	2.87
17.0 - 17.9							39	0.00
18.0 - 18.9							39	0.00
19.0 - 19.9							39	0.00
20.0 - 20.9			26	13		39	39	2.83
21.0 +								0.00
TOTAL		143	539	278	39			2.71
CUM. TOTAL	1000	1000	857	317	39			
COL. AVG.	0.00	13.77	13.87	14.63	15.93	14.14		

AVERAGE SIG. HEIGHT = 2.71 FT AVERAGE WAVE PERIOD = 14.03 SEC
 VARIANCE OF SIG. HEIGHT = .47 FT SQ VARIANCE OF WAVE PERIOD = 10.80 SEC SQ
 STANDARD DEVIATION OF HEIGHT = .69 FT STANDARD DEVIATION OF PERIOD = 3.28 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.
 * CALCS ARE OMITTED.

284 OBSERVATIONS

SUMMARY FOR AUG 72 AUG 73 AUG 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT.*	CUM. TOT.*	RDW. AVG.*
0.0 - .9												1000	0.00
1.0 - 1.9		4									4	1000	1.50
2.0 - 2.9			4								4	996	1.50
3.0 - 3.9	7	7		4							18	993	1.50
4.0 - 4.9												975	0.00
5.0 - 5.9												975	0.00
6.0 - 6.9		4	7								11	975	1.83
7.0 - 7.9			4	4							7	965	3.00
8.0 - 8.9		7	7	14							28	958	2.75
9.0 - 9.9		4	14	11	7	4					39	930	3.32
10.0 - 10.9		7	7	32	14	4	4				67	891	3.66
11.0 - 11.9												824	0.00
12.0 - 12.9	4	49	70	21		11		4			158	824	2.59
13.0 - 13.9												665	0.00
14.0 - 14.9	11	102	225	92	7	4	4		4	4	451	665	2.62
15.0 - 15.9												215	0.00
16.0 - 16.9	11	42	88	53	11						204	215	2.55
17.0 - 17.9												11	0.00
18.0 - 18.9												11	0.00
19.0 - 19.9												11	0.00
20.0 - 20.9			7	4							11	11	2.83
21.0 +													0.00
TOTAL	39	222	430	232	39	21	7	4	4	4			2.67
CUM. TOTAL	1000	961	739	310	77	39	18	11	7	4			
COL. AVG.	10.95	13.50	14.16	13.45	12.68	12.00	12.50	12.50	14.50	14.50	13.61		

AVERAGE SIG. HEIGHT = 2.63 FT AVERAGE WAVE PERIOD = 13.06 SEC
 VARIANCE OF SIG. HEIGHT = 1.45 FT SQ VARIANCE OF WAVE PERIOD = 8.14 SEC SQ
 STANDARD DEVIATION OF HEIGHT = 1.20 FT STANDARD DEVIATION OF PERIOD = 2.85 SEC

236 OBSERVATIONS

SUMMARY FOR SEP 72 SEP 73 SEP 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9									1000	0.00
1.0 - 1.9									1000	0.00
2.0 - 2.9									1000	0.00
3.0 - 3.9									1000	0.00
4.0 - 4.9									1000	0.00
5.0 - 5.9		4						4	1000	1.50
6.0 - 6.9			8					8	996	2.50
7.0 - 7.9				4				4	987	3.50
8.0 - 8.9			13	4	4			21	983	3.10
9.0 - 9.9		4						4	982	1.50
10.0 - 10.9		4	4					8	958	2.00
11.0 - 11.9									949	0.00
12.0 - 12.9	13	81	50	21	13	4		161	949	2.21
13.0 - 13.9									788	0.00
14.0 - 14.9	13	119	220	47	21	4	4	428	788	2.44
15.0 - 15.9									360	0.00
16.0 - 16.9	4	72	148	110	17			352	360	2.68
17.0 - 17.9									8	0.00
18.0 - 18.9									8	0.00
19.0 - 19.9									8	0.00
20.0 - 20.9		4	4					8	8	2.00
21.0 +										0.00
TOTAL	30	288	428	186	55	8	4			2.49
CUM. TOTAL	1000	970	682	254	68	13	4			
COL. AVG.	13.93	14.26	14.74	15.16	14.19	13.50	14.50	14.61		

AVERAGE SIG. HEIGHT = 2.45 FT

AVERAGE WAVE PERIOD = 14.47 SEC*

VARIANCE OF SIG. HEIGHT = .87 FT SQ

VARIANCE OF WAVE PERIOD = 4.85 SEC SQ*

STANDARD DEVIATION OF HEIGHT = .93 FT

STANDARD DEVIATION OF PERIOD = 2.20 SEC*

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE

WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.

* CALMS ARE OMITTED.

278 OBSERVATIONS

SUMMARY FOR OCT 72 OCT 73 OCT 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0=1	1=2	2=3	3=4	4=5	5=6	6=7	7=8	TOT.*	CUM. TOT.*	ROW AVG.*
0.0 - .9										1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9										1000	0.00
3.0 - 3.9	4								4	1000	.50
4.0 - 4.9					4				4	996	4.50
5.0 - 5.9			4						4	993	2.50
6.0 - 6.9			4	7	7				18	989	3.70
7.0 - 7.9			4	4	11				18	971	3.90
8.0 - 8.9			11	4	4				18	953	3.10
9.0 - 9.9										935	0.00
10.0 - 10.9		18	11						29	935	1.88
11.0 - 11.9										906	0.00
12.0 - 12.9	14	58	54	14	18	7			165	906	2.41
13.0 - 13.9										741	0.00
14.0 - 14.9	18	101	183	61	14	4	4	4	388	741	2.49
15.0 - 15.9										353	0.00
16.0 - 16.9	11	32	140	90	22	4			299	353	2.80
17.0 - 17.9										54	0.00
18.0 - 18.9										54	0.00
19.0 - 19.9										54	0.00
20.0 - 20.9	4	22	14	14					54	54	2.23
21.0 +											0.00
TOTAL	50	230	424	194	79	14	4	4			2.60
CUM. TOTAL	1000	950	719	295	101	22	7	4			
COL. AVG.	14.00	14.53	14.65	15.19	12.18	14.00	14.50	14.50	14.49		

AVERAGE SIG. HEIGHT = 2.57 FT

AVERAGE WAVE PERIOD = 14.34 SEC*

VARIANCE OF SIG. HEIGHT = 1.15 FT SQ

VARIANCE OF WAVE PERIOD = 4.24 SEC SQ*

STANDARD DEVIATION OF HEIGHT = 1.07 FT

STANDARD DEVIATION OF PERIOD = 2.07 SEC*

284 OBSERVATIONS

SUMMARY FOR NOV 72 NOV 73 NOV 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9										1000	0.00
1.0 - 1.9										1000	0.00
2.0 - 2.9										1000	0.00
3.0 - 3.9										1000	1.50
4.0 - 4.9		4								4	996 3.50
5.0 - 5.9			7			4		4		14	993 4.50
6.0 - 6.9		4	4	21			4			32	979 3.50
7.0 - 7.9			14	11	4			4		32	947 3.61
8.0 - 8.9		11	35	21	7	4	7			65	915 3.25
9.0 - 9.9		14	14	11						39	831 2.41
10.0 - 10.9	7	7	32	14	4	4				67	792 2.66
11.0 - 11.9											725 0.00
12.0 - 12.9	21	67	63	70	28	4				254	725 2.61
13.0 - 13.9											472 0.00
14.0 - 14.9	7	81	92	81	11		4			275	472 2.58
15.0 - 15.9											197 0.00
16.0 - 16.9	14	88	56	21		4	4			187	197 2.12
17.0 - 17.9											11 0.00
18.0 - 18.9											11 0.00
19.0 - 19.9											11 0.00
20.0 - 20.9			11							11	11 2.50
21.0 +											0.00
TOTAL	49	275	327	254	53	18	18	7			2.64
CUM. TOTAL	1000	951	676	349	95	42	25	7			
COL. AVG.	13.64	13.87	12.82	12.08	11.90	10.70	10.90	6.50	12.79		

AVERAGE SIG. HEIGHT = 2.59 FT

AVERAGE WAVE PERIOD = 12.68 SEC

VARIANCE OF SIG. HEIGHT = 1.40 FT SQ

VARIANCE OF WAVE PERIOD = 9.48 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.18 FT

STANDARD DEVIATION OF PERIOD = 3.08 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HUNTINGTON REACH PIER.
 * CALMS ARE OMITTED.

115 OBSERVATIONS

SUMMARY FOR DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOT.	CUM. TOT.	ROW AVG.
0.0 - .9											1000	0.00
1.0 - 1.9											1000	0.00
2.0 - 2.9											1000	0.00
3.0 - 3.9				9						9	1000	3.50
4.0 - 4.9											991	0.00
5.0 - 5.9			9		9	9				26	991	4.17
6.0 - 6.9			17	9						26	965	2.83
7.0 - 7.9				17	17		9			43	939	4.50
8.0 - 8.9		35	26	26	9	17				113	896	3.04
9.0 - 9.9		17	17	17						52	783	2.50
10.0 - 10.9		9	35	9						52	730	2.50
11.0 - 11.9											678	0.00
12.0 - 12.9		9	183	70	9		9		9	287	678	3.08
13.0 - 13.9											391	0.00
14.0 - 14.9		35	157	104	26	9				330	391	2.95
15.0 - 15.9											61	0.00
16.0 - 16.9		26	26							52	61	2.00
17.0 - 17.9											9	0.00
18.0 - 18.9											9	0.00
19.0 - 19.9											9	0.00
20.0 - 20.9			9							9	9	1.50
21.0 +												0.00
TOTAL		139	470	261	70	35	17		9			2.99
CUM. TOTAL	1000	1000	861	391	130	61	26	9	9			
COL. AVG.	0.00	12.75	12.56	11.80	10.63	9.25	10.00	0.00	12.50	12.09		

AVERAGE SIG. HEIGHT = 3.00 FT

AVERAGE WAVE PERIOD = 11.95 SEC

VARIANCE OF SIG. HEIGHT = 1.27 FT SQ

VARIANCE OF WAVE PERIOD = 8.20 SEC SQ

STANDARD DEVIATION OF HEIGHT = 1.13 FT

STANDARD DEVIATION OF PERIOD = 2.86 SEC

2888 OBSERVATIONS

SUMMARY FOR 31 MONTHS FEB 72 THROUGH DEC 74

PERIOD
(SECS)

SIG. HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOT.	CUM. TOT.	NO. AVG.
0.0 - .9												1000	0.00
1.0 - 1.9												1000	.50
2.0 - 2.9												1000	1.50
3.0 - 3.9	1	1	2	5								8	999 2.67
4.0 - 4.9		1	3	2	1							4	991 3.62
5.0 - 5.9		2	3	3	2	1		1				12	987 3.50
6.0 - 6.9		2	0	7	0			1				24	975 3.40
7.0 - 7.9			0	0	0	2	2					25	951 3.87
8.0 - 8.9			7	19	10	12	5	3		1		66	926 3.59
9.0 - 9.9			0	0	5	1						19	860 2.70
10.0 - 10.9	1	10	15	10	4	2	1					43	860 2.87
11.0 - 11.9													798 0.00
12.0 - 12.9	5	50	84	66	20	7	1					214	798 2.77
13.0 - 13.9													503 0.00
14.0 - 14.9	5	58	174	86	20	6	2	1				352	503 2.77
15.0 - 15.9													231 0.00
16.0 - 16.9	4	33	91	65	16	2	1					213	231 2.81
17.0 - 17.9													18 0.00
18.0 - 18.9													18 0.00
19.0 - 19.9													18 0.00
20.0 - 20.9													18 0.00
21.0 -													18 0.00
TOTAL	16	171	421	261	88	29	11	3	1	1			8.00
CUM. TOTAL	1000	980	812	391	130	63	17	6	2	1			2.89
COL. AVG.	13.07	13.45	13.78	13.28	12.12	11.69	10.63	8.80	11.00	11.50	13.33		

AVERAGE SIG. HEIGHT = 2.86 FT AVERAGE WAVE PERIOD = 13.18 SEC
 VARIANCE OF SIG. HEIGHT = 1.21 FT² VARIANCE OF WAVE PERIOD = 0.68 SEC²
 STANDARD DEVIATION OF HEIGHT = 1.10 FT STANDARD DEVIATION OF PERIOD = 3.11 SEC

RESULTS OBTAINED FROM 1024-SECOND DIGITAL RECORDS TAKEN WITH A CONTINUOUS WIRE
 WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.
 * CALCS ARE OMITTED.

6294 OBSERVATIONS

SUMMARY FOR 36 MONTHS MAR 64 THROUGH APR 67

PERIOD
(SECS)

HEIGHT (FT)

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	TOT.	CUM. TOT.	NO. AVG.
0.0 - 1.0	15									1000	.00
2.0 - 2.9										1000	.00
2.5 - 2.9										1000	.00
3.0 - 3.9	1	1								2	1000 1.00
3.5 - 3.9	1	3								5	998 1.43
4.0 - 4.9		3	1							4	994 1.82
5.0 - 5.9	1	3	1							5	990 1.95
6.0 - 6.9	4	10	4	2						21	988 1.72
7.0 - 7.9	6	23	9	2						40	983 1.94
8.0 - 8.9	7	27	14	4	1					53	970 1.89
9.0 - 9.9	7	30	18	4	1					59	864 1.82
10.0 - 10.9	8	30	11	3	1					54	810 1.78
11.0 - 11.9	10	44	18	5	1	1				81	754 1.82
12.0 - 12.9	20	86	29	9	4	1				152	673 1.82
13.0 - 13.9	23	170	36	6	2		1			171	522 1.71
14.0 - 14.9	34	146	62	10	5					271	350 1.80
15.0 - 15.9	1	7	2	1						12	80 1.97
16.0 - 16.9	3	27	16	0	3	1				59	67 2.28
17.0 - 17.9											8 2.50
18.0 - 18.9											8 2.86
TOTAL	162	545	219	66	21	5	2				1.81
CUM. TOTAL	1000	898	513	94	29	8	3				
COL. AVG.	12.14	12.46	12.88	12.82	12.72	11.05	11.29	14.00	12.89		

AVERAGE SIG. HEIGHT = 1.80 FT AVERAGE WAVE PERIOD = 12.89 SEC
 VARIANCE OF SIG. HEIGHT = .86 FT² VARIANCE OF WAVE PERIOD = 7.14 SEC²
 STANDARD DEVIATION OF HEIGHT = .93 FT STANDARD DEVIATION OF PERIOD = 2.67 SEC

RESULTS OBTAINED FROM 7-MINUTE PEN AND TNC RECORDS TAKEN WITH A STEP RESISTANCE
 WAVE GAGE LOCATED AT HUNTINGTON BEACH PIER.
 * CALCS ARE OMITTED.
 Wave heights may be low due to old gage design and maintenance difficulties.

Table A-68. Comparison of results from different pen and ink wave record analysis methods, Huntington Beach, California.

Dates of data sample reanalyzed by CERC method	Significant heights ¹			Significant periods ²		
	Correlation between heights	A (ft)	B	Correlation between periods	C (s)	D
July 1950	0.93	0.02	0.89	0.69	3.00	0.70
Mar. 1951	0.77	0.25	0.82	0.56	3.78	0.61
Jan. 1958	0.81	0.09	0.65	0.50	2.12	0.75
Feb. 1960	0.89	0.07	0.81	0.54	2.34	0.81
Nov. to Dec. 1962	0.85	0.54	0.64	0.64	5.03	0.59

¹Significant height from the CERC method
 $= A + B \times (\text{significant height from old method}).$

²Significant period from the CERC method
 $= C + D \times (\text{significant period from old method}).$

Table A-69. Regression equations used to compensate significant height statistics for Huntington Beach, California.

Year	Compensation equations (ft)
1949 to 1950	$H_{NEW} = 0.02 + 0.89 H_{OLD}$
1951 to 1953	$H_{NEW} = 0.25 + 0.82 H_{OLD}$
1954 to 1958	$H_{NEW} = 0.09 + 0.65 H_{OLD}$
1959 to 1960	$H_{NEW} = 0.07 + 0.81 H_{OLD}$
1961 to 1963	$H_{NEW} = 0.54 + 0.64 H_{OLD}$
1964 to 1974	No compensation

NOTE:

H_{NEW} = estimate of significant height that would have been obtained by the CERC method of pen and ink record analysis.

H_{OLD} = significant height obtained by old method of pen and ink record analysis.

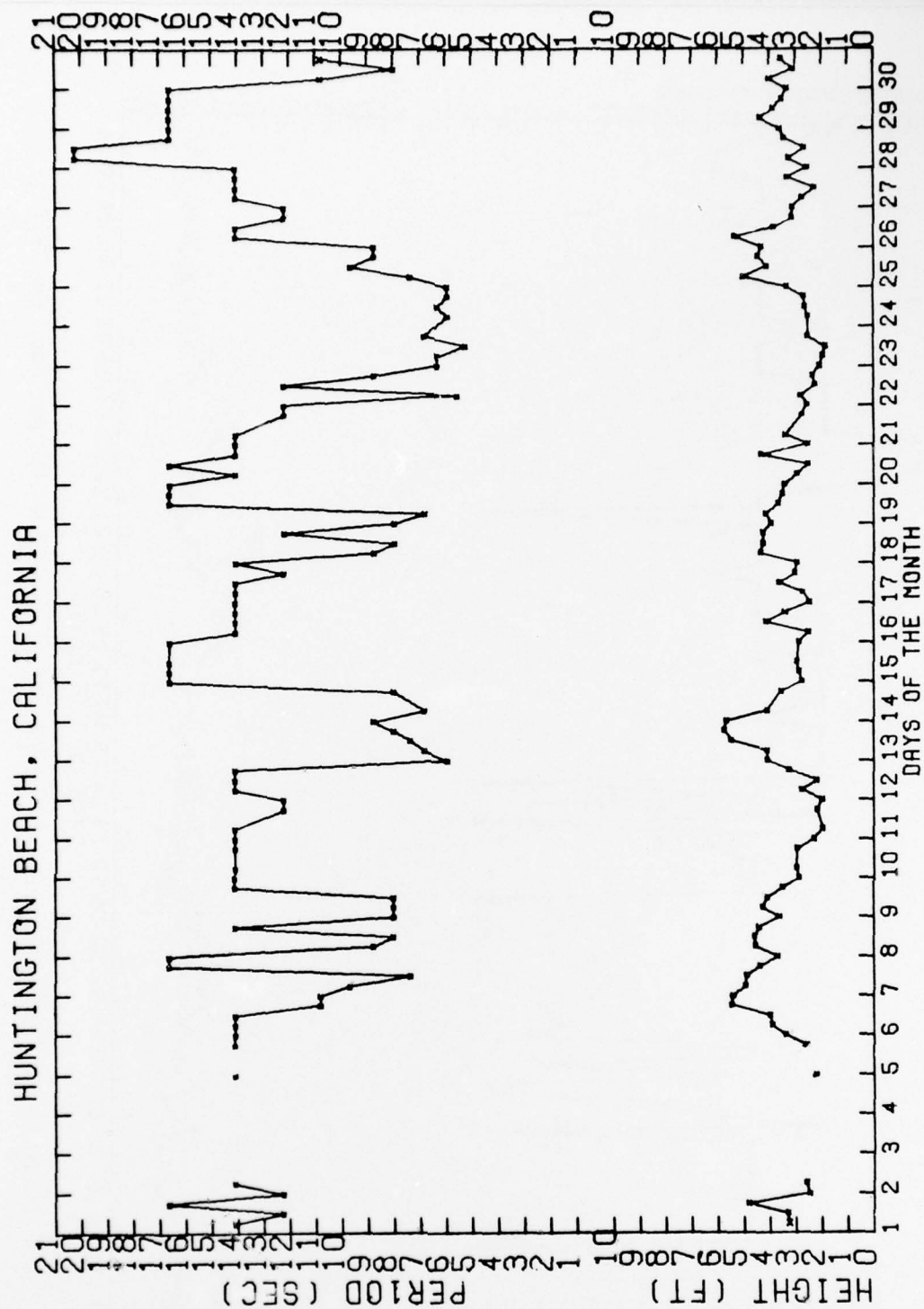


Figure A-108. Time history of significant wave heights and periods, April 1972.

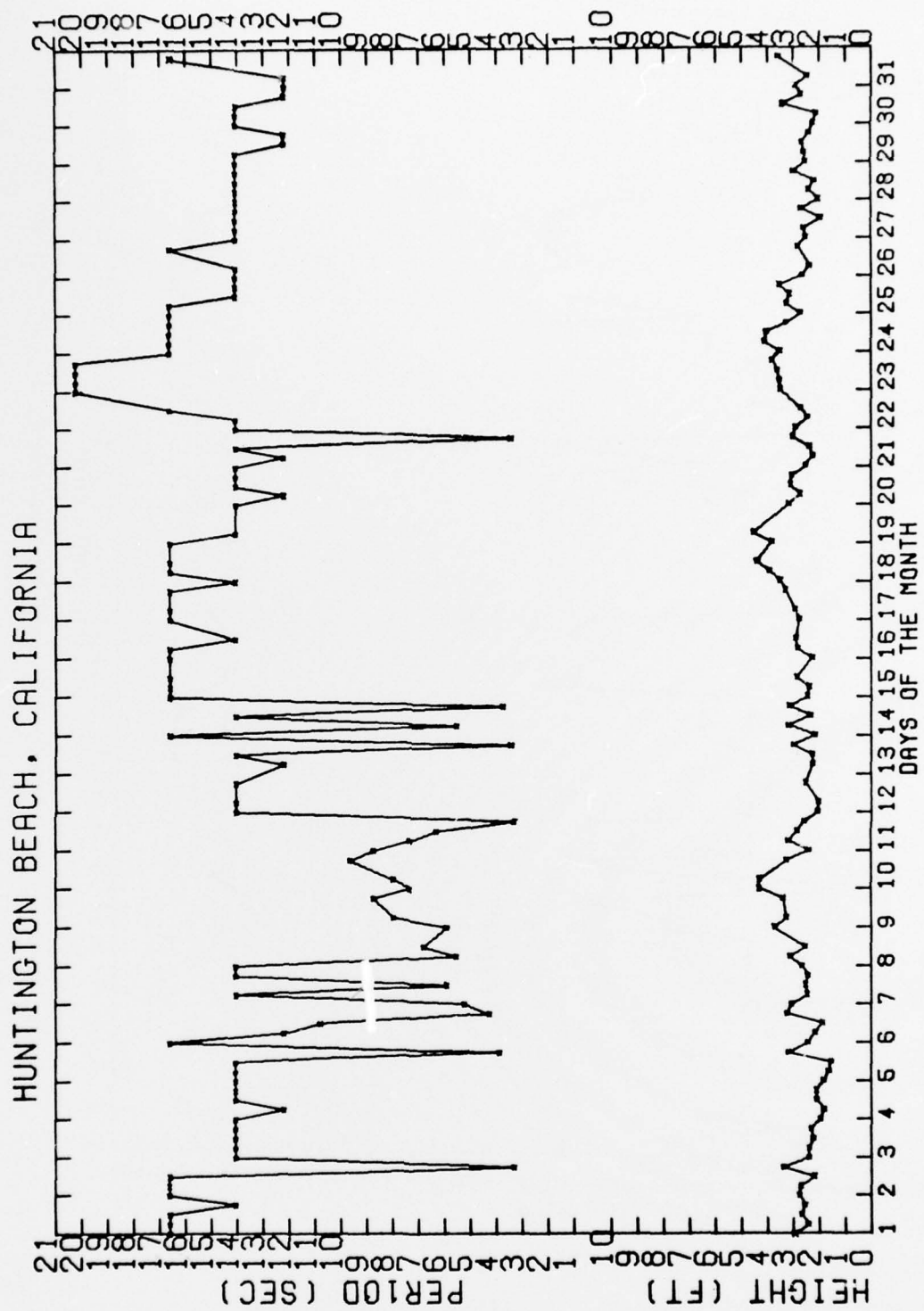


Figure A-109. Time history of significant wave heights and periods, May 1972.

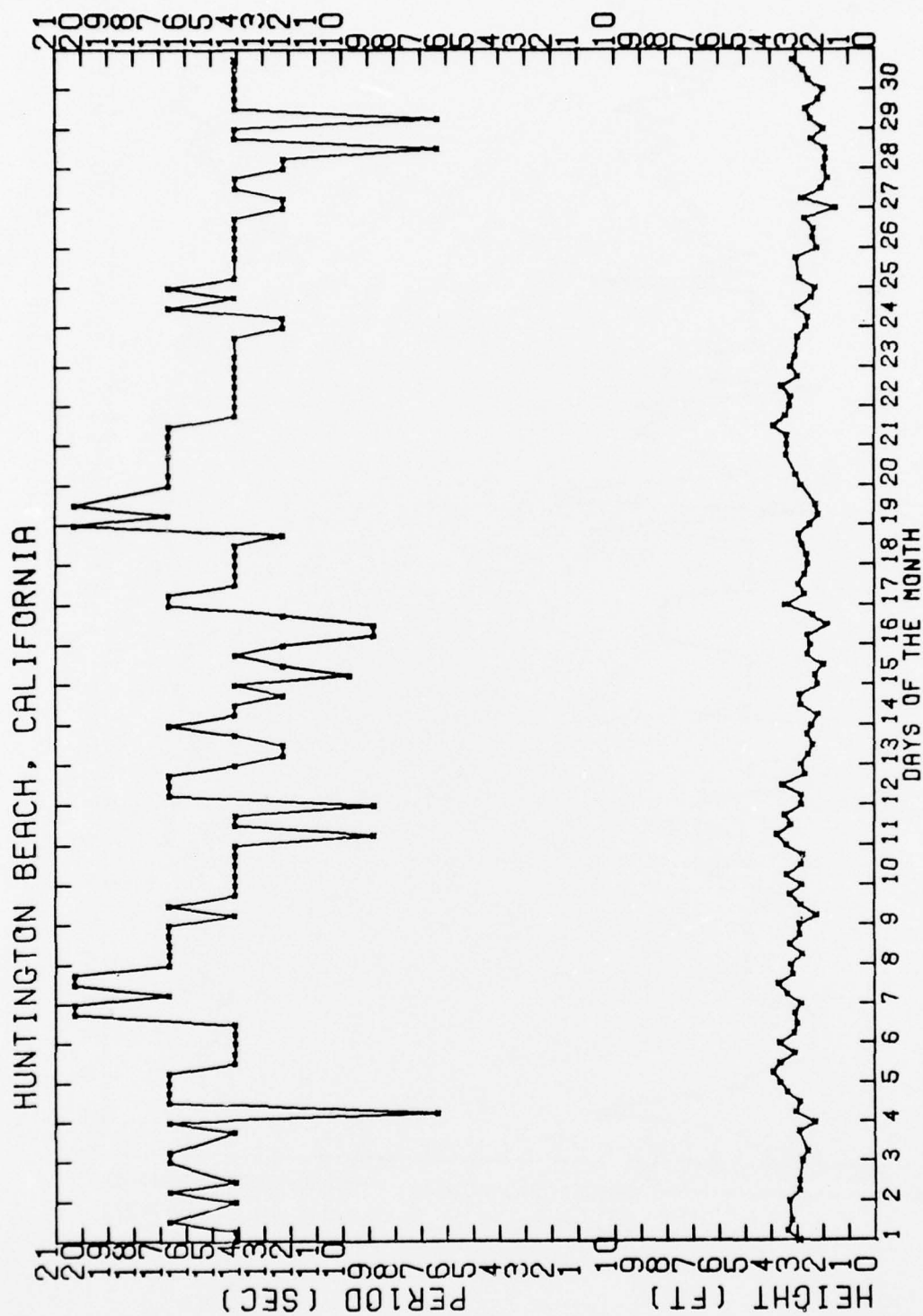


Figure A-110. Time history of significant wave heights and periods, June 1972.

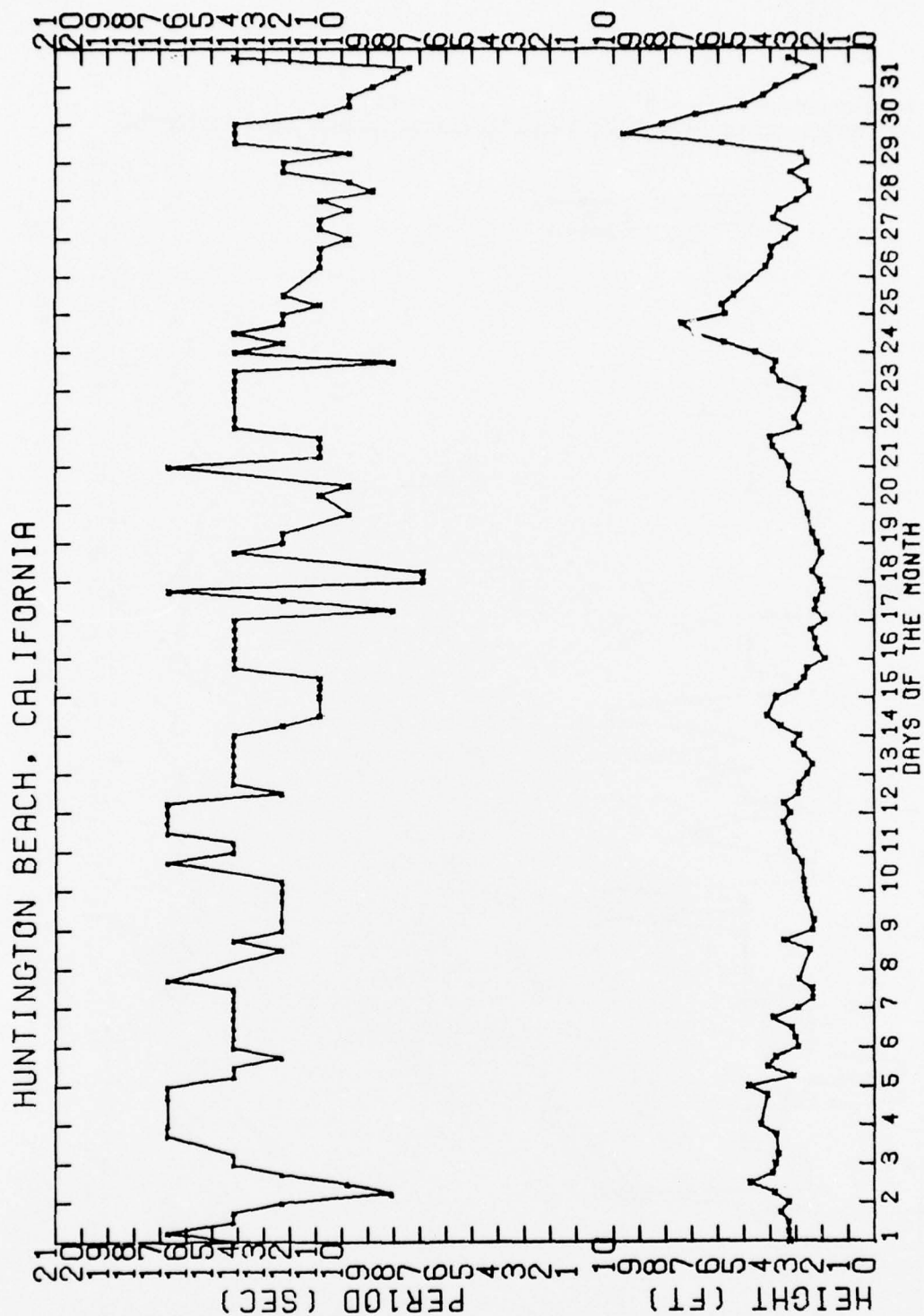
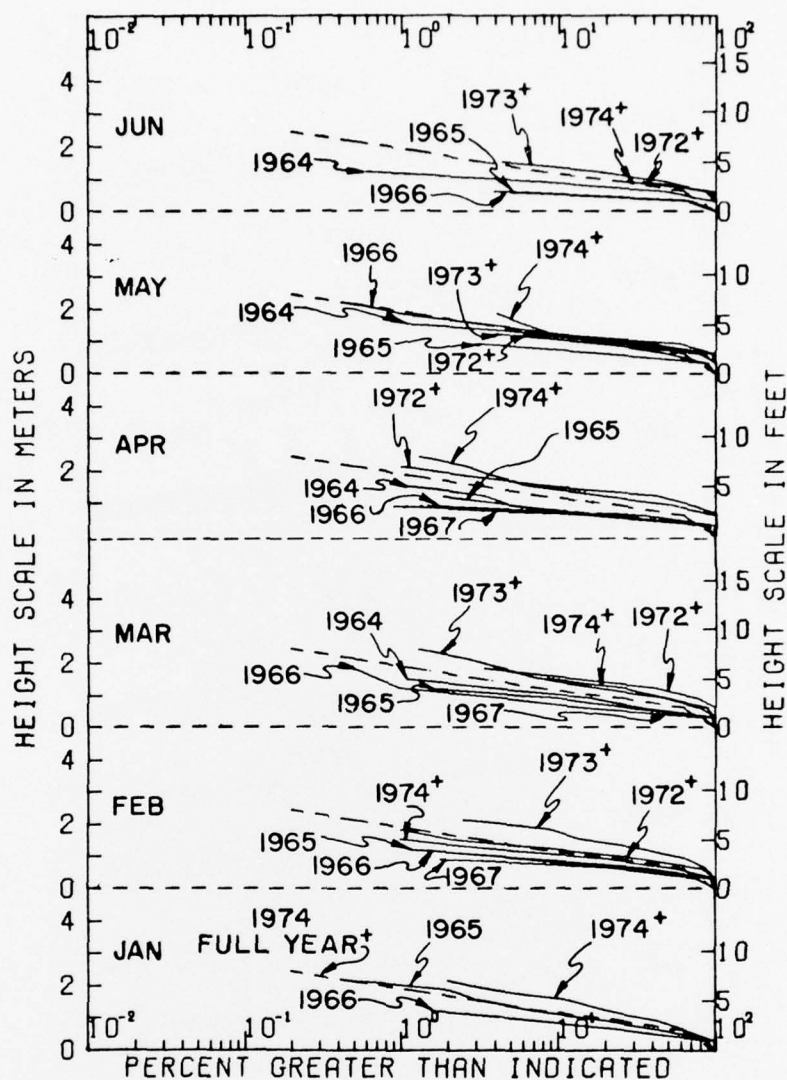


Figure A-111. Time history of significant wave heights and periods, July 1972.

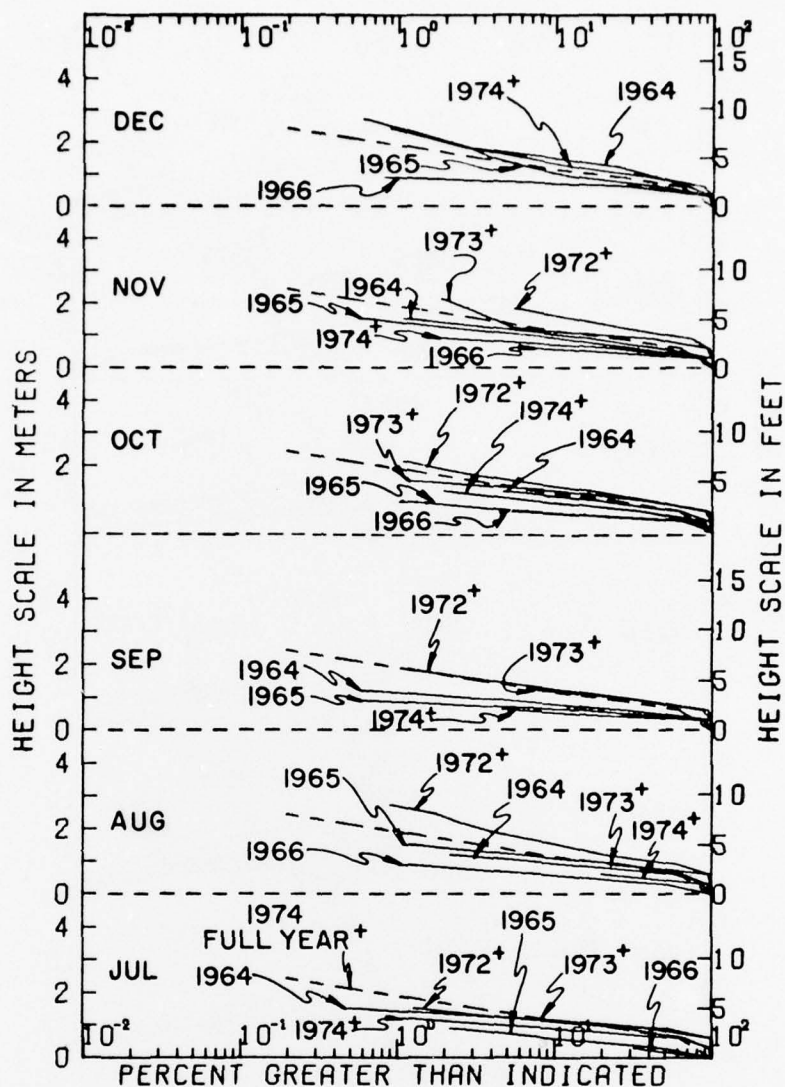


NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily; wave heights may be low due to old gage design and maintenance difficulties.

Figure A-112. Monthly cumulative significant height distributions from Huntington Beach, California.



NOTE:

+ = computed from 1,024-second digital wave records taken four times daily.

Unmarked = determined from 7-minute pen and ink records taken six times daily; wave heights may be low due to old gage design and maintenance difficulties.

Figure A-112. Monthly cumulative significant height distributions from Huntington Beach, California.--Continued

APPENDIX B

PROCEDURE FOR ANALYSIS OF WAVE DATA FROM 7-MINUTE PEN AND INK RECORDS (BASED ON A RAYLEIGH DISTRIBUTION FOR WAVE HEIGHT)

1. Run the period template (Fig. B-1) along the 7-minute record until a group of fairly uniform waves is found which should contain some of the highest waves. A template can be fabricated on a clear overlay such as acetate.
2. Determine the appropriate period of the waves selected in step 1 by using the template according to instructions. When the wave period on the chart falls between two of the periods shown on the template, the analyzer may approximate what is considered to be nearest to the exact period; e.g., if the period is about the same amount longer than the 5-second period, then it is shorter than the 6-second period, the period must be about 5.5 seconds.
3. Use the table below to determine which wave should be measured in the full 7-minute record to get the approximate significant height of the waves. The wave number is determined by calling the highest wave in the full 7-minute record as wave number 1; the second highest wave is number 2, etc. Wave height is defined as the difference in elevation between a wave crest and the preceding trough.

Wave period (seconds)	Number of wave to measure
3.0	19
3.5	16
4.0	14
4.5	13
5.0	11
5.5	10
6.0	9
7.0	8
8.0	7
9.0	6
10.0	6
11.0	5
12.0	5
13.0	4
14.0	4
15.0	4
16.0	4

4. Determine the height of the wave given by step 3, in terms of small divisions on the chart paper.
5. Using the appropriate relationship between chart paper divisions and actual elevations in feet, convert the wave height determined in step 4 from chart divisions to feet. Estimate to the nearest tenth of a foot.

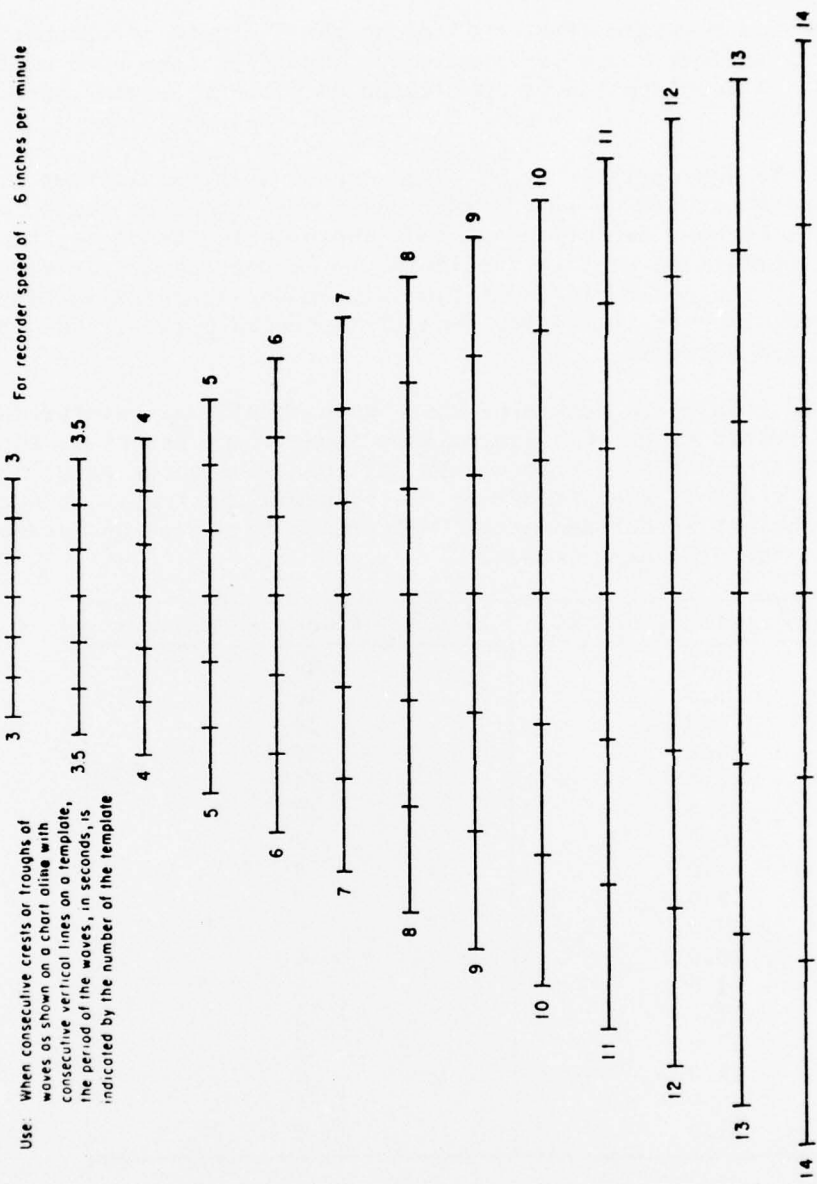


Figure B-1. Sample wave-period template (from Williams, 1969).

6. Tabulate the data on CERC Form 118-72 (Fig. B-2) or an equivalent. The form has five columns containing the following data: (a) The month, day, and year is indicated under "Date"; (b) the beginning time of the wave record such as 0400 is indicated under "Time of Start"; (c) the significant wave period in seconds is listed under "Period"; (d) the significant wave height in feet is listed under "Height"; and (e) the "Peak" column which can be used for maximum wave height when desired.

Recorder

[illegible]

CERC 118-72
5 May 72

Figure B-2. Form for tabulating wave data.

<p>Thompson, Edward F.</p> <p>Wave climate at selected locations along U.S. coasts / by Edward F. Thompson. - Fort Belvoir, Va. : U.S. Coastal Engineering Research Center, 1977. 364 p. : ill. (Technical report - U.S. Coastal Engineering Research Center ; no. 77-1) Bibliography : p. 56.</p> <p>Significant heights and periods for 19 wave gage locations are summarized, and provide data on ranges, annual and seasonal variations of wave climate. Staff and pressure-sensitive gages, generally shore-based, were used to obtain the data.</p> <p>1. Wave records. 2. Wave height. 3. Wave gages. 1. Title. II. Series: U.S. Coastal Engineering Research Center. Technical report no. 77-1.</p> <p>TC203 .U581tr no. 77-1 627</p>	<p>Thompson, Edward F.</p> <p>Wave climate at selected locations along U.S. coasts / by Edward F. Thompson. - Fort Belvoir, Va. : U.S. Coastal Engineering Research Center, 1977. 364 p. : ill. (Technical report - U.S. Coastal Engineering Research Center ; no. 77-1) Bibliography : p. 56.</p> <p>Significant heights and periods for 19 wave gage locations are summarized, and provide data on ranges, annual and seasonal variations of wave climate. Staff and pressure-sensitive gages, generally shore-based, were used to obtain the data.</p> <p>1. Wave records. 2. Wave height. 3. Wave gages. 1. Title. II. Series: U.S. Coastal Engineering Research Center. Technical report no. 77-1.</p> <p>TC203 .U581tr no. 77-1 627</p>
<p>Thompson, Edward F.</p> <p>Wave climate at selected locations along U.S. coasts / by Edward F. Thompson. - Fort Belvoir, Va. : U.S. Coastal Engineering Research Center, 1977. 364 p. : ill. (Technical report - U.S. Coastal Engineering Research Center ; no. 77-1) Bibliography : p. 56.</p> <p>Significant heights and periods for 19 wave gage locations are summarized, and provide data on ranges, annual and seasonal variations of wave climate. Staff and pressure-sensitive gages, generally shore-based, were used to obtain the data.</p> <p>1. Wave records. 2. Wave height. 3. Wave gages. 1. Title. II. Series: U.S. Coastal Engineering Research Center. Technical report no. 77-1.</p> <p>TC203 .U581tr no. 77-1 627</p>	<p>Thompson, Edward F.</p> <p>Wave climate at selected locations along U.S. coasts / by Edward F. Thompson. - Fort Belvoir, Va. : U.S. Coastal Engineering Research Center, 1977. 364 p. : ill. (Technical report - U.S. Coastal Engineering Research Center ; no. 77-1) Bibliography : p. 56.</p> <p>Significant heights and periods for 19 wave gage locations are summarized, and provide data on ranges, annual and seasonal variations of wave climate. Staff and pressure-sensitive gages, generally shore-based, were used to obtain the data.</p> <p>1. Wave records. 2. Wave height. 3. Wave gages. 1. Title. II. Series: U.S. Coastal Engineering Research Center. Technical report no. 77-1.</p> <p>TC203 .U581tr no. 77-1 627</p>